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no. 87

INSTRUCTIONS FOR PLANTING TREE SEED

By Joseph F. Kaylor, *Assistant State Forester*

Preparation of Soil. Select a plot of good soil preferably in a garden. For five hundred seeds mark off a seedbed or space two feet by four feet. This should be spaded and a path shoveled around it so as to raise the plot above the surrounding soil. Next rake the soil as fine as possible to a depth of five or six inches.

Sowing the Seed. Fig. 1. The seedbed is now ready for the seed. These should be scattered broadcast over the fine soil so the seedlings will not crowd each other after germination.

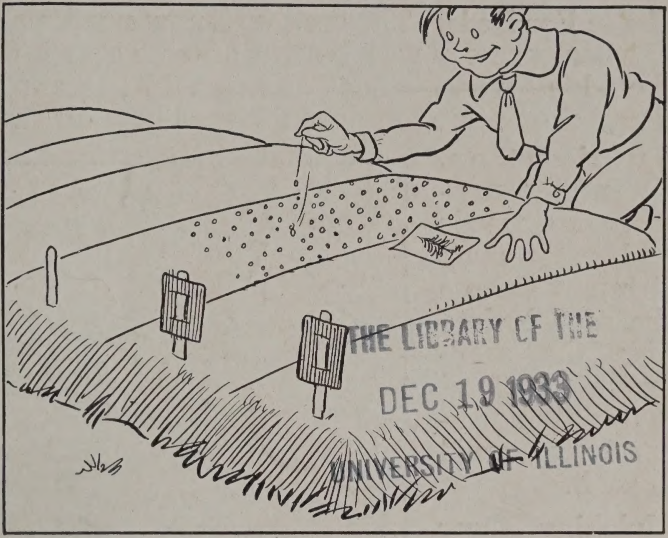

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Figure 1

Covering the Seed. Fig. 2. The seedbed next needs a covering of fine rich soil or sand. This should be placed over the seeds to about one-half inch in depth. Care must be taken to get the soil or sand deep enough but not over one-half inch.

Mulch. The seedbed should be covered to a depth of 3 or 4″ with leaves or straw. Then place lath or lightweight strips of wood over the leaf cover to hold it in place. The leaves or straw will keep the soil warm and moist about the seed and hasten their germination.

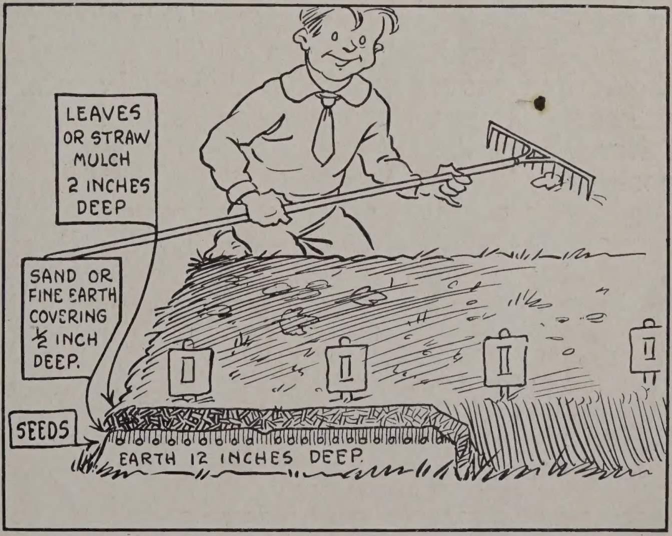
LEAVES OR STRAW MULCH 2 INCHES DEEP
SAND OR FINE EARTH COVERING ½ INCH DEEP.
SEEDS
EARTH 12 INCHES DEEP

Figure 2

Uncovering the Seedbed. Fig. 3. The seed will germinate in from one to four weeks after sowing. As soon as they appear above the soil the mulch cover should be removed. The best time to do this is late in the afternoon so that the tender seedlings will be protected from the intense heat of the sun.

Shade For Beds. The seedlings now need a shade cover of lath, or a heavy screen with boughs of trees over it for protection. This should be placed about eighteen inches above the trees. The shade should remain over the seedlings all summer.

Cultivation. During the summer the weeds and grass must be removed from the seed bed to give the seedlings all the food material necessary for rapid growth.

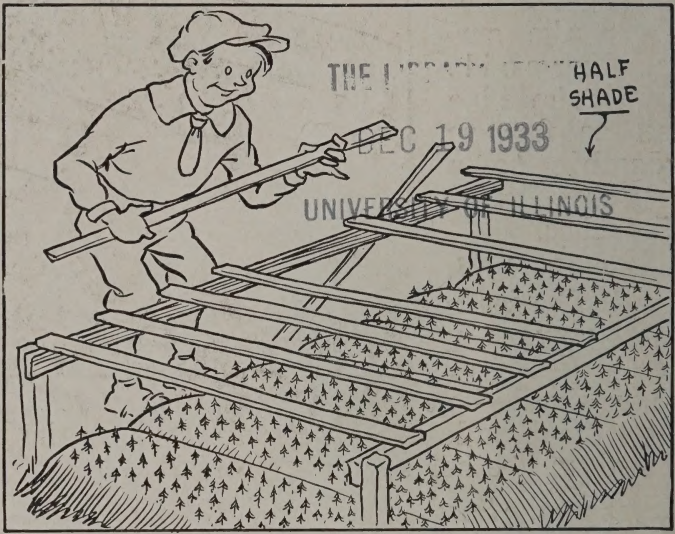

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Figure 3

Mulching Over Winter. Before the soil freezes the trees should be covered with a deep layer of leaves or straw to protect them for the winter. This should be weighted down to keep it from blowing away. The following spring the mulch should be removed and the bed shaded again.

The seedlings will require shading and mulching for two years. After the third year they are ready to transplant to their final position.

DID YOU KNOW THAT THE DIVISION OF FORESTRY

1. Distributes forest tree seedlings from the State Nursery for ½c and 1c each?
2. These trees are to be planted for forests and windbreaks? (No trees are furnished for door yards or ornamental planting.)
3. Classifies both native woodlands and waste lands (if planted to forest trees) for tax exemption?
4. Supplies forestry information to woodland owners?
5. Conducts forestry research experiments and manages the State Forests?

STATE OF INDIANA
THE DEPARTMENT OF CONSERVATION — DIVISION OF FORESTRY

RICHARD LIEBER, Director
CONSERVATION COMMISSION
STANLEY COULTER, Chairman   MARTIN R. GOSHORN
DAVID A. ROTHROCK   KNOWLES B. SMITH

R. F. WILCOX, State Forester
Department Publication 87
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THE DEPARTMENT OF CONSERVATION
STATE OF INDIANA

1929 SUPPLEMENT

TO

INDIANA CONSERVATION LAWS 1927

PUBLICATION No. 88

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Relating to Conservation in Indiana and being Supplemental to Publication No. 68, Indiana Conservation Laws 1927.

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RICHARD LIEBER
Director

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I

Indiana Acts, 1929

Sec. 1. Department of Conservation—Appropriations—Definition of Terms. That the term "operating expense" as used in this act shall be construed to include "personal service" and "all other operating expenses," as hereinafter defined.

The term "personal service" wherever used in this act shall be construed to include all payments made as and for salaries and wages to any and all officers and employes of the state, whether regular or temporary.

The term "all other operating expenses" wherever used in this act shall be construed to include all payments made for fuel, food, cleaning, disinfecting, refrigeration, clothing, forage, printing, light, heat, power, water, transportation, communication, traveling, laundering and all payments for medical, laboratory, disinfecting, educational, agricultural, vehicle, office and other supplies and materials, and all payments made for the repair of buildings, highways, sewers, vehicles, and all other general repairs.

The term "capital outlays" as used in this act shall be construed to include "equipment," "lands," "structures," and "non-structural improvements," as hereinafter defined.

The term "equipment" as used in this act shall be construed to include machinery, implements, tools, furniture, furnishings, live stock, vehicles and any and all other equipment which has a calculable period of service.

The term "lands" as used in this act shall be construed to include any and all new lands acquired, together with the accrued tax thereon.

The term "structures" as used in this act shall be construed to include new buildings, additions to buildings and betterments.

The term "non-structural" as used in this act shall be construed to include new driveways, sidewalks, sewers, tunnels, landscaping, and other similar improvements.

The term "fixed charges" as used in this act shall be construed to include payments made on the state debt, interest on the state debt, rent, insurance, premiums on official bonds, public improvement assessments, association dues and contributions.

All money herein appropriated is appropriated on the following basis and subject to the following conditions:

(a) Any and all money from whatever source derived, accruing to the state treasury by virtue of the provisions of any laws, is hereby devoted exclusively and appropriated for the purpose or purposes designated and prescribed in the law under and by virtue of which such money is collected and received.

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(b) If the law under and by virtue of which such money is collected and received does not designate or prescribe a specific purpose or purposes for which such money so derived shall be expended, such money shall be considered to be available for use for any purposes which may be designated by law.

All money herein appropriated shall be considered either as direct appropriations or as rotary or revolving fund appropriations.

Direct appropriations shall be subject to withdrawal from the state treasury as needed and for expenditure for such purpose or purposes as may be designated or prescribed by law, and where once withdrawn shall not be subject to return or to rewithdrawal from the state treasury except for the correction of errors which may have occurred in any transactions.

A rotary or revolving fund is any designated part of the general fund which is set apart as working capital and devoted by law to a specific purpose. The fund may consist of an appropriation made thereto, together with any income from the fund so used; or the fund may consist of earnings and income only from certain sources. However derived, the money in such fund shall be used exclusively for the purpose designated by law as a working capital. All or any part of the money in the fund may be withdrawn at any time. The whole or any part of the money so withdrawn may be repaid at any time. The fund at any time shall consist of the original appropriation made thereto, if any; all receipts accruing to such fund; and all money withdrawn and invested or to be invested. The money constituting such fund shall be kept intact by separate entries in the auditor's office and no part thereof shall be used for any purpose other than the lawful purpose of the fund or be transferred or revert to any other fund at any time, except that any excess over and above any prescribed amount shall be transferred to the general fund at the close of each fiscal year. Acts 1929, p. 340, Sec. 1.

Sec. 2. Department of Conservation—Appropriations. That for the conduct of the state government, its offices, boards, commissions, departments, institutions, societies, associations, services, agencies, and undertakings, and other appropriations not otherwise provided by statute, the following sums are hereby appropriated for the periods of time herein designated:

Department of Conservation—

(a) For the department of conservation:

Operating expense:

Personal service for the fiscal year beginning October 1, 1929, one hundred forty-eight thousand dollars ($148,000).

Personal service for the fiscal year beginning October 1, 1930, one hundred forty-eight thousand dollars ($148,000).

All other operating expenses for the fiscal year beginning October 1, 1929, sixty-two thousand dollars ($62,000).

All other operating expenses for the fiscal year beginning October 1, 1930, sixty-two thousand dollars ($62,000).

Capital outlays:

Equipment for the fiscal year beginning October 1, 1929, twenty thousand dollars ($20,000).

Equipment for the fiscal year beginning October 1, 1930, twenty thousand dollars ($20,000).

Lands and structures for the fiscal year beginning October 1, 1929, one hundred fifty thousand dollars ($150,000).

Lands and structures for the fiscal year beginning October 1, 1930, one hundred fifty thousand dollars ($150,000).

Lands and structures, for non-structural improvements and purchase of additional lands, available April 1, 1929, for the period ending September 30, 1929, five thousand dollars ($5,000).

Fixed charges for the fiscal year beginning October 1, 1929, four thousand four hundred dollars ($4,400).

Fixed charges for the fiscal year beginning October 1, 1930, four thousand four hundred dollars ($4,400).

Provided, That all funds accruing to the use of any division of the department of conservation other than the division of fish and game and other than regular or specific appropriations made by the general assembly, shall be deemed to constitute a rotary fund for the use of the respective divisions and no part of such fund shall revert to the state treasury at the close of any fiscal year until any such rotary fund shall reach the amount of twenty-five thousand dollars, in which event all sums in excess of twenty-five thousand dollars shall revert to the state treasury at the end of each fiscal year and shall be added to the general funds of the state.

(b) Nancy Hanks Lincoln burial ground:

Operating expense:

Personal service for the fiscal year beginning October 1, 1929, four thousand dollars ($4,000).

Personal service for the fiscal year beginning October 1, 1930, four thousand dollars ($4,000).

All other operating expenses for the fiscal year beginning October 1, 1929, one thousand seven hundred fifty dollars ($1,750).

All other operating expenses for the fiscal year beginning October 1, 1930, one thousand seven hundred fifty dollars ($1,750).

Capital outlays:

Non-structural improvements, for the biennial period beginning October 1, 1929, and ending September 30, 1931, twenty-five thousand dollars ($25,000).

(c) Tippecanoe battle ground:

Operating expense:

Personal service for the fiscal year beginning October 1, 1929, five hundred dollars ($500).

Personal service for the fiscal year beginning October 1, 1930, five hundred dollars ($500).

All other operating expenses for the fiscal year beginning October 1, 1929, five hundred dollars ($500).

All other operating expenses for the fiscal year beginning October 1, 1930, five hundred dollars ($500).

(d) Lanier home:

For completing restoration and maintenance of home for the fiscal year beginning October 1, 1929, eight thousand dollars ($8,000).

For completing restoration and maintenance of home for the fiscal year beginning October 1, 1930, five thousand dollars ($5,000).

(e) Corydon capitol and grounds:

For completing restoration and maintenance of old state capitol building and grounds to original condition and plans, for the fiscal year beginning October 1, 1929, three thousand dollars ($3,000).

For completing restoration and maintenance of old state capitol building and grounds to original condition and plans, for the fiscal year beginning October 1, 1930, three thousand dollars ($3,000).

(f) Division of fish and game:

Operating expense:

Personal service for the fiscal year beginning October 1, 1929, one hundred thousand dollars ($100,000).

Personal service for the fiscal year beginning October 1, 1930, one hundred thousand dollars ($100,000).

All other operating expenses for the fiscal year beginning October 1, 1929, forty-five thousand dollars ($45,000).

All other operating expenses for the fiscal year beginning October 1, 1930, forty-five thousand dollars ($45,000).

Capital outlays:

Equipment for the fiscal year beginning October 1, 1929, ten thousand dollars ($10,000).

Equipment for the fiscal year beginning October 1, 1930, ten thousand dollars ($10,000).

Lands, structures, and non-structural improvements, for the fiscal year beginning October 1, 1929, forty-four thousand dollars ($44,000).

Lands, structures, and non-structural improvements, for the fiscal year beginning October 1, 1930, forty-four thousand dollars ($44,000).

Fixed charges for the fiscal year beginning October 1, 1929, one thousand dollars ($1,000).

Fixed charges for the fiscal year beginning October 1, 1930, one thousand dollars ($1,000).

Provided, That all fees received by division of fish and game shall be paid into the general fund of the state: and, Provided, further, That the expenditures shall not exceed the amount so paid into the state treasury: and, Provided, further, That the unexpended balance of all funds which may be in and remaining to the credit of the fish and game protective and propagation fund on September 30, 1929, and at the end of any ensuing fiscal year, shall be transferred by the auditor of state to the general fund, and the amount so transferred, together with all fees, income or receipts thereafter collected in excess of the amounts hereinbefore appropriated are hereby appropriated to the department of conservation for the development of fish and game projects, including the employment of game wardens. Acts 1929, p. 340, Sec. 2.

Sec. 3. Department of Conservation—Appropriations. All salaries or compensation of deputies, assistants, stenographers, clerks or other subordinate employes shall be paid directly to and receipted for by such deputies, assistants, stenographers, clerks or other subordinate employes, who shall make and file affidavits that they have actually performed the services for which said salary or compensation is paid, and that no part thereof has been or is to be directly or indirectly divided with or paid to any other person on account of or by reason of such employment.

Salaries of all state officers and employes provided for by this act shall be paid monthly on the first day of each month for the preceding month.

All appropriations herein provided, and all appropriations otherwise provided by statute, designated or intended as and for traveling and hotel expenses for any department officer, agent, employe, person, trustee or commissioner, shall be construed to mean and are hereby intended to be confined to such traveling and hotel expenses within the State of Indiana and not elsewhere; this, however, shall not apply, when such expenses are directed or approved by the governor; nor shall the above apply to those expenses incurred in going after paroled, discharged or escaped persons, inmates of any of the institutions of this state, or children who are public wards, or to the traveling expenses of the attorney general or his deputies or assistants when in the discharge of their duties as required by law. Acts 1929, p. 340, Sec. 3.

Sec. 4. Department of Conservation—Appropriations. No voucher for any of the items embraced within the classification of operating expense, capital outlays or fixed charges shall be payable in advance: Provided, That nothing in this act shall prevent the state board of finance, whenever the same may in its judgment be deemed necessary and expedient in conducting the business of this state, authorizing advance payments to the board or persons having control of the funds of any of the institutions or departments of the state of such sums of money out of any appropriation available at such time for the items of operating expense, capital outlays or fixed charges provided for said institutions or departments as may be required to establish a working capital and provide for the payment of expenses in those cases in which an emergency may exist for immediate payment. Such advance payments shall be made by warrant of the auditor of state, properly itemized and receipted by such boards or persons receiving such advance payments: Provided, further, That nothing in this act shall prevent any unexpended balance which may remain in any appropriation or appropriations for structures after the completion of the project for which an appropriation is specifically made from being used, upon the approval of the governor, for the construction of other needed buildings or for the repair of buildings. Acts 1929, p. 340, Sec. 4.

Sec. 5. Department of Conservation—Appropriations. No monthly warrant for operating expenses, capital outlays or fixed charges, shall be issued to any department or institution unless the receipts of said department or institution shall have been covered into the state treasury for the month preceding, unless otherwise provided by statute: Provided, That in case of loss by fire to any state institution, the proceeds derived from insurance shall be deposited in the state treasury and said amount so deposited is hereby reappropriated to such institutions for the purpose of replacing the loss. Acts 1929, p. 340, Sec. 5.

Sec. 6. Department of Conservation—Appropriations. The purchase of any of the items included under all other operating expenses, or equipment that may enter into maintenance, repairs, or equipment of any institution or department of the state government covered by this appropriation act, shall be by competitive bids as far as is practicable, and to this end it shall be the duty of the proper authorities to invite competitive bids through sealed proposals to the president of the board of trustees, in the case of an institution, and the head of the department, in the case of any other department of the state government, affected by this proviso, and the lowest and best responsible bidder shall be awarded the contract: Provided, That this requirement shall not apply to articles manufactured at the Indiana reformatory, Indiana state prison, Indiana state farm and the board of industrial aid for the blind. Acts 1929, p. 340, Sec. 6.

Sec. 7. Department of Conservation—Appropriations. In order to carry out the provisions of this act, the state board of finance is hereby given authority to make available any part of the annual appropriation, for the succeeding fiscal year, for operating expense and equipment for any institution or department of state government: Provided, That such action shall be taken by the state board of finance only after such board has determined that an actual emergency exists for making such appropriations available from said appropriations for the succeeding fiscal year: and, Provided, further, That any institution or department of state government actually in need of having such appropriations made available from the appropriations for the succeeding fiscal year shall submit to the state board of finance a statement showing the necessity therefor, the reason for such appropriation being exhausted and an itemized account of the expenditures made from such appropriation. Acts 1929, p. 340, Sec. 9.

Sec. 8. Department of Conservation—Appropriations. Any person or persons, officer or officers, board of trustees, commission or commissions, who shall overdraw, expend or contract for the expenditure of any money in excess of the amounts or for any other and different purpose or purposes than as herein specified and intended, shall be guilty of a misdemeanor, and upon conviction shall be fined in any sum not less than one hundred dollars ($100) nor more than one thousand dollars ($1,000), to which may be added imprisonment in the Indiana state farm not less than thirty (30) days nor more than six (6) months. Acts 1929, p. 340, Sec. 10.

Sec. 9. Department of Conservation—Appropriations. Whenever an appropriation is made in this act for construction or repairs of buildings for any state institution, the appropriation herein provided shall be expended under the superintendent of such institution unless otherwise specifically provided: Provided, That no contract shall be awarded for the construction of any building, for which an appropriation is made in this act, by virtue of the terms of which contract the architect is to be paid on a percentage basis: and, Provided, further, That the board of trustees or other authority having charge of the construction of any such building or buildings may employ a superintendent of construction or an architect for his services at an agreed rate per day, or on any other satisfactory basis, except a percentage basis, and no money appropriated by any of the provisions of this act shall be expended to pay the compensation of any superintendent of construction or architect who has been employed with the understanding that he is to receive a certain agreed per cent of the cost of the construction of such building as compensation for his services. Acts 1929, p. 340, Sec. 12.

Sec. 10. Vacation of Highways in State Parks, State Forest Reserves, State Game Reserves and Scenic and Historic Places. That all public highways or parts thereof, except state highways, inside the boundaries of the several state parks, state forest reserves, state game reserves, and scenic and historic places owned by the State of Indiana, are hereby vacated as such highways. The department of conservation is hereby authorized in its discretion to maintain and keep such roadways open to the public, or to close the same: Provided, That in any case where any privately owned lands would, by such vacation, become inaccessible by public highway, in such case so much of any such highway as shall provide public access to and outlet from such lands shall not be deemed to be vacated so long as such condition exists. Acts 1929, p. 186, Sec. 1.

Sec. 11. State Highways Authorized to be Constructed From State Highways to State Parks, State Forest Reserves, State Game Reserves, State Institutions, and Recreational, Scenic and Historical Places. The state highway commission is hereby authorized and empowered to lay out, construct and maintain, as a part of the state highway system, highways which will connect any state highway, now existing or hereafter constructed, with any state park, state forest reserve, state game reserve, the grounds of any state institution or any recreational, scenic or historic place owned or operated by the state. Such connecting highways shall be laid out, constructed and maintained in the same manner as is now or hereafter may be provided by law for the laying out, construction and maintenance of state highways. Acts 1929, p. 455, Sec. 1.

Sec. 12. Fish and Game—Close Season—Fish—Large-mouth Bass—Bluegill—Yellow Perch—Pike—Pickerel—Silver Bass—Rock Bass—Red-eared Sunfish—Pike-perch—Crappie. It shall be unlawful for any person to take, catch, kill, pursue or possess any small-mouth black bass (Micropterus dolomieu), large-mouth black bass (Micropterus salmoides), bluegills (Lepomis pallidus), yellow perch (Perca flavescens), pike or pickerel (Esox lucius), silver bass (Morone interrupta), rock bass (Ambloplites rupestris, commonly known as red-eye or goggle-eye), red-eared sunfish (Eupomotis heros), pike-perch (Stizostedion vitreum, commonly known as wall-eye or jack-salmon), or crappie (Pomoxis sparoides and Pomoxis annularis), native to this state, from the first day of May to the fifteenth day of June (both dates inclusive) of each year. Provided, That proof that any fish of any of said species was possessed in this state shall be prima facie evidence that such fish was native to this state. Acts 1929, p. 323, Sec. 1, amending Acts 1927, p. 93, Sec. 29. See Indiana Conservation Laws 1927, Sec. 170.

Sec. 13. Fish and Game—Close Season—Raccoon—Fox—Opossum—Skunk—Mink—Muskrat. No person shall take, trap, shoot, kill or possess any raccoon, fox, opossum, skunk, mink or muskrat or possess the freshly skinned hide or fur thereof in the State of Indiana from the 15th day of January to the 15th day of November of any year: Provided, That for the purpose of disposing of the same, any person may, for a period of five days after the 15th day of January, possess any such animals, or the freshly skinned hide or fur thereof, which have been taken in open season as herein provided: Provided, further, That when any of the animals mentioned in this section are found injuring or doing damage to, or destroying any property the owner of such property may kill them on his premises when necessary for the protection of his own property, but such owner shall, thereupon, and within five days after having killed such animal or animals, report such fact to the department of conservation and such department shall provide for the sale or disposition of the hide or fur of such animal or animals, and the proceeds thereby obtained shall be added to the fish and game protective and propagation fund. Any person violating this section or any of the provisions thereof, shall be deemed guilty of a misdemeanor and shall upon conviction thereof be fined in any sum, not less than five dollars ($5) nor more than fifty dollars ($50) for each offense, to which may be added imprisonment in the county jail not to exceed thirty days. Acts 1929, p. 11, Sec. 1, amending Acts 1921, p. 624, Sec. 4. See Indiana Conservation Laws 1927, Sec. 138.

Sec. 14. Fish and Game—Lake Michigan. All fish of whatever kind in the waters of Lake Michigan within the jurisdiction of the State of Indiana shall be, and are hereby declared to be the property of the State of Indiana, and shall not be taken, transported, sold or possessed contrary to the provisions of this act. Acts 1929, p. 461, Sec. 1.

Sec. 15. Fish and Game—Lake Michigan—License. It shall be unlawful for any person, firm or corporation to take any fish from the waters of Lake Michigan within the jurisdiction of Indiana with or by means of a boat, tug, launch, net, nets or other commercial fishing gear, without first procuring and at the time having a license therefor as hereinafter provided. Acts 1929, p. 461, Sec. 2.

Sec. 16. Fish and Game—Lake Michigan—License. Such licenses shall be issued by the superintendent of fisheries and game, in the form prescribed by him, upon the payment to him of the following respective fees:

(a) For residents of Indiana: For the use of one or more nets of any kind without a boat, or under the ice, one dollar; for each sail boat or row boat propelled by oars or sail, five dollars; for each power boat propelled by steam, gasoline, naptha, electricity or other motive power, of less than fifteen tons gross tonnage, ten dollars; for each boat of any kind over fifteen tons gross tonnage, twenty-five dollars.

(b) For non-residents of Indiana: For the use of one or more nets of any kind without a boat, or under the ice, five dollars; for each sail boat or row boat propelled by oars or sail, ten dollars; for each power boat propelled by steam, gasoline, naptha, electricity or other motive power, of less than ten tons gross tonnage, fifty dollars; for each boat of any kind of more than ten tons gross tonnage, five dollars for each gross ton, not to exceed, however, three hundred dollars for any one boat. For the purpose of this act, the computation of gross tonnage shall be made as registered by the United States government.

A resident of Indiana, within the meaning of this section, shall be a person who is at the time and who has been continuously for the full period of six months next preceding a bona fide resident of this state; or in case of a corporation, one organized under the laws of this state, in which seventy-five per cent or more of its stock is and has been actually owned by bona fide residents of this state, as above defined, for more than six months prior to the time of making application for license; or in case of a firm, one in which each member is a resident of Indiana as above defined; otherwise a person, firm or corporation, as the case may be, shall be deemed to be a non-resident of Indiana. It shall be unlawful for any non-resident of Indiana falsely to represent to the superintendent of fisheries and game that he, said non-resident, is a resident of Indiana, for the purpose of procuring a resident license under this act. Any license so procured shall be absolutely void and shall confer no right or privilege to take fish in said waters. Acts 1929, p. 461, Sec. 3.

Sec. 17. Fish and Game—Lake Michigan—License. Such license shall expire on the first day of June next following the date of issue. It shall not be transferable or assignable, except that the department of conservation may, upon application therefor, permit the temporary transfer of such license to any similar boat during such period of time as the licensed boat is disabled and undergoing repairs. It shall be unlawful for any person to change, alter, forge or counterfeit any such license. Each licensee hereunder shall be subject to the provisions of this act, and of any act hereafter in force for the protection of fish in Lake Michigan within the jurisdiction of Indiana, and such licensee may take such fish during the respective seasons only when it shall be lawful to do so, and in lawful manner only. And such license shall be issued upon the express condition, to which condition the licensee, by the acceptance of the license, shall be deemed to agree and consent, that the licensee shall make reports to the superintendent of fisheries and game as hereinafter provided by section 6. Any such license may be revoked at any time by the superintendent of fisheries and game for failure to comply with or for violation of the terms of such license or of this act. All boat or net licenses issued by the superintendent of fisheries and game for said waters prior to the passage of this act under law then existing, shall be and continue in force for the full period for which they were issued. Acts 1929, p. 461, Sec. 4.

Sec. 18. Fish and Game—Lake Michigan—License. All such license fees received by the superintendent of fisheries and game shall be by him paid into the state treasury during the calendar month next succeeding the receipt thereof, which moneys shall be and become a part of the fish and game protection and propagation fund. Acts 1929, p. 461, Sec. 5.

Sec. 19. Fish and Game—Lake Michigan—License. Each licensee hereunder shall keep an accurate record for each day's catch, of the number of pounds of each kind of fish taken, of the locality fished, of the kind and amount of fishing gear employed, of the length of time each unit of gear was fished without being lifted, of the kind and amount of spawn taken, of the kind and amount of caviar taken, and such other data as the superintendent of fisheries and game may require, and shall on the first day of each month report (under oath when requested so to do) all the above data for the preceding month to the superintendent of fisheries and game upon blanks therefor to be furnished by said superintendent. Such report shall so be made each month regardless whether or not any fish were taken during the preceding month, and if no fish were taken, the fact shall be so noted. The failure of any licensee promptly to make any such report shall be cause for revocation of the license and for denial of a new license or renewal of license. Acts 1929, p. 461, Sec. 6.

Sec. 20. Fish and Game—Lake Michigan—Nets. It shall be unlawful for any person, firm or corporation to use in the waters of Lake Michigan within the jurisdiction of Indiana any pound or trap net, gill net, seine, or any fixed, set or movable net of any kind or description whatever, the character, kind, meshes and construction of which are different than prescribed by this section as follows: Gill nets with meshes of not less than four and one-half inches may be used for the taking of whitefish and trout. Gill nets with meshes of not less than two and one-half inches nor more than two and seven-eighths inches may be used for taking chubs and perch, wherever and whenever they will not take to exceed ten per centum by weight of other fish, such percentage to be determined by the department of conservation or its officers or agents by inspection of the fish taken. Gill nets with meshes of not less than two and three-eighths inches may be used for taking blue-back herring, wherever and whenever they will not take to exceed ten per centum by weight of other fish, such percentage to be determined by the department of conservation or its officers or agents by inspection of the fish taken: Provided, That all uninjured fish, except herring, chubs and perch, shall be returned to the waters from which they were taken with as little injury as possible, by the person or persons lifting the net or nets. The department of conservation shall remove or cause to be removed any of such nets whenever or wherever, from said inspection, it shall determine that such nets are taking more fish other than herring, chubs and perch than allowed by the provisions of this section. Gill nets with meshes of not less than one and one-half inches nor more than two inches may be used for the purpose of procuring bait for use in baiting hook lines, when and where such nets will not take undersize fish. No gill net above mentioned shall have a greater measurement than eleven feet in depth. Pound nets with the pot, crib or pocket, being that part of the net in which fish are finally captured, having meshes of not less than three and one-half inches in the bottom, sides and front, with the back having meshes of not more than two inches, for at least fifteen feet below the surface of the water, with the lead having meshes of not less than five inches, the funnel and the heart having meshes of not less than four inches, may be used for taking whitefish and trout. Pound nets, with the front, sides and bottom of the pot, crib or pocket having meshes of not less than two and one-fourth inches and the back having meshes of not more than two inches, the funnel inside of the pot, crib or pocket two and one-fourth inches, and such part of the funnel outside of the crib or pocket with the heart and lead four inches, may be used for the purpose of taking perch, herring and other rough fish. The size of meshes of all gill nets as prescribed in this section shall be determined by extension measure as found in use; the size of all pound net meshes shall be determined by extension measure as manufactured. Extension measure shall mean the distance between the extreme angles of any single mesh and such measurement shall be after the twine is taut without any strain whatever and shall be between and inside the knots. Provided, that any and all nets now existing and in use or possessed for use in said waters which would be lawful for use under the provisions of the act approved February 28, 1917, being Acts 1917, page 94, may lawfully be used for the purposes and in the manner therein set forth until the first day of December, 1930; otherwise all nets and mesh twine the use of which is unlawful under this act shall be confiscated by the department of conservation. Acts 1929, p. 461, Sec. 7.

Sec. 21. Fish and Game—Lake Michigan—Close Season. It shall be unlawful for any person, firm or corporation to take for commercial purposes from the waters of Lake Michigan within the jurisdiction of this state any lake trout from the twentieth day of October to the twenty-second day of November, both dates inclusive, in each year; or any perch from the fifteenth day of April to the fifteenth day of June, both dates inclusive, in each year; or any whitefish from the fifth day of November to the fifteenth day of December, both dates inclusive, in each year. It shall be unlawful to set nets for the taking of trout or whitefish before the first day of the respective open season for taking said fish. Any person, firm or corporation engaged in the taking of fish for commercial purposes from May fifteenth to September fifteenth, both dates inclusive, in each year, under the provisions of this act, shall carry sufficient ice and properly chill such fish at the time and place of their removal from the water. Acts 1929, p. 461, Sec. 8.

Sec. 22. Fish and Game—Lake Michigan—Size of Fish. It shall be unlawful for any person, firm or corporation to market, sell, offer for sale or to possess for the purpose of sale at any time in this state, whether caught within or without this state, any:

(a) Whitefish, of a less weight than two pounds in the round, or one pound and ten onces when dressed, and one pound and six ounces when dressed, head off and salted;

(b) Lake trout, of a less weight than one and one-half pounds in the round, or one and one-fourth pounds when dressed;

(c) Perch, of a less length than eight inches. Acts 1929, p. 461, Sec 9.

Sec. 23. Fish and Game—Lake Michigan—Size of Fish. It shall be unlawful for any person, firm or corporation using pound nets in said waters of Lake Michigan to take with such nets from said waters any fish of smaller size than established by section 9 of this act, and all such undersize fish found in such nets shall be returned to such waters with as little injury as possible by the person or persons lifting such net or nets: Provided, That it shall not be unlawful for such fisherman to possess not to exceed in quantity the percentage allowed in section 7 of this act, of lake trout, whitefish or perch of a less weight or length than established by this act which are caught in two and one-half inch mesh gill nets, but the same may be transported, sold or disposed of only under the direction and with the permission of the department of conservation. Acts 1929, p. 461, Sec. 10.

Sec. 24. Fish and Game—Lake Michigan—Hook and Line Fishing. The provisions of this act shall not apply to the taking of fish from said waters of Lake Michigan with hook and line by persons for their own use and not for sale nor for commercial purposes, but in such case and as to such persons the same laws and regulations as apply to inland waters shall apply and are hereby made to apply to said waters of Lake Michigan and to the fish and fishing therein. Said laws applying to inland waters and to the fish and fishing therein shall not apply to commercial fishing or to fish taken for commercial purposes in Lake Michigan under this act. Acts 1929, p. 461, Sec. 11.

Sec. 25. Fish and Game—Lake Michigan—Game Fish. It shall be unlawful for any person, firm or corporation to take or catch with any kind of a net or other commercial fishing device or gear in the waters of Lake Michigan within the jurisdiction of Indiana any large-mouth black bass, small-mouth black bass, warmouth bass, white bass, calico or strawberry bass, crappie, bluegill, sunfish, green sunfish, brook or speckled trout, rainbow trout, steelhead trout, brown trout, Loch Leven trout, muskellunge, or sturgeon, or to sell, offer for sale or to possess at any time any of said fish taken in said manner. Any such fish found in such net, device or gear shall at once be returned to said waters with as little harm as possible to said fish. It shall be unlawful to take or catch any sturgeon at any time in any manner in said waters. Acts 1929, p. 461, Sec. 12.

Sec. 26. **Fish and Game—Lake Michigan—Buoys and Flags.** It shall be unlawful for any person, firm or corporation to set or use nets in any of the waters mentioned in this act without marking the location of and identifying said nets by marking with buoys and attaching to the buoys flags at least four feet above the surface of the water and showing on the buoys the license number of the person, firm or corporation using such nets. Acts 1929, p. 461, Sec. 13.

Sec. 27. **Fish and Game—Lake Michigan—Fish Taken for Scientific or Propagation Purposes.** The provisions of this act shall not apply to the department of conservation or its officers, agents or employes in the taking of fish in said waters for propagation or scientific purposes. The department of conservation may take and appropriate for cultural, propagation or scientific purposes only, fish or fish eggs taken from said waters by any person, firm or corporation fishing therein, and in such case shall pay to such person, firm or corporation such price as may be agreed upon, or the fair and current market value thereof. Acts 1929, p. 461, Sec. 14.

Sec. 28. **Fish and Game—Lake Michigan—Title to Fish.** The title to any and all fish taken from said waters in violation of the provisions of this act shall not vest in the taker thereof, but shall be and remain in the State of Indiana, and such fish shall be confiscated in the name of the state by the department of conservation and sold or disposed of as such department may direct, and the proceeds thereof, if any, shall be paid into the state treasury as part of the fish and game propagation and protection fund. Acts 1929, p. 461, Sec. 15.

Sec. 29. **Fish and Game—Lake Michigan—Filth and Offal.** All offal or filth of any description whatever accruing from the catching, curing, cleaning or shipping of fish in or near the waters mentioned in this act shall be burned, buried, or otherwise disposed of in such sanitary manner as not to pollute such waters and as not to be or become detrimental to public health or comfort. Acts 1929, p. 461, Sec. 16.

Sec. 30. **Fish and Game—Lake Michigan—Penalty.** Any person, firm or corporation violating any provision of this act shall be deemed guilty of a misdemeanor and upon conviction thereof shall be punished by a fine of not less than twenty-five dollars nor more than one hundred dollars, or by imprisonment of such person for a period not exceeding sixty days, or by both such fine and imprisonment. Each violation of any provision of this act shall constitute a separate and distinct offense. Acts 1929, p. 461, Sec. 17.

Sec. 31. **Fish and Game—Lake Michigan—Repeal.** The act approved February 28, 1917, entitled "An act for the protection of fish in Lake Michigan," being Acts 1917, pages 94 to 99, is hereby repealed. Acts 1929, p. 461, Sec. 18.

Sec. 32. **Fish and Game—Arrests—Resistance.** That whoever shall forcibly assault, resist, oppose, obstruct, prevent, impede or interfere with any peace or police officer of this state, or any person assisting him, while such officer is arresting or attempting to arrest any person, or while such officer is engaged in the execution of any of the duties of such peace or police officer, shall be deemed guilty of a misdemeanor, and, upon conviction thereof, shall be fined not to exceed one hundred dollars or imprisoned in the county jail or Indiana state farm not more than six months, or both; and whoever shall draw, use or attempt to use a firearm, deadly or dangerous weapon, or commit a bodily injury upon any peace or police officer of this state, or upon any person assisting such peace or police officer, while assaulting, resisting, opposing, obstructing, preventing, impeding or interfering with any peace or police officer, when such officer is arresting or attempting to arrest any person, or while such officer is engaged in the execution of any of the duties of such officer, shall be deemed guilty of a felony, and, upon conviction thereof, shall be imprisoned in the state prison for a period of one year. Acts 1929, p. 310, Sec. 1.

Sec. 33. **Forestry—Arbor Day.** That for the purpose of encouraging the planting of shade and forest trees, shrubs and vines, the second Friday of April in each year is hereby designated as a day for general observance to be known as Arbor Day. Acts 1929, p. 523, Sec. 1, amending Acts 1913, p. 422, Sec. 1. See Indiana Conservation Laws 1927, Sec. 232.

Sec. 34. **Forestry—Tax Levy—Forestry Fund.** That in the year 1929, and annually thereafter, there shall be levied and collected as other state taxes are levied and collected the sum of two mills upon each one hundred dollars worth of taxable property in this state, which money, when collected, shall be paid into the state treasury and shall constitute a state forestry fund. Acts 1929, p. 324, Sec. 1, amending Acts 1927, p. 397, Sec. 1. See Indiana Conservation Laws 1927, Sec. 210.

Sec. 35. **Forestry—City, Town or County Public Forest—Co-operation of Division of Forestry.** Such public forests shall be under the supervision of the board of commissioners in the case of a county, of the common council in the case of a city, and of the board of trustees in the case of an incorporated town, and they are hereby authorized and empowered, either separately or in co-operation, to employ necessary and competent supervisors and laborers to properly protect and care for such forests and to perform the necessary duties connected therewith, and any county, city or incorporated town owning and holding land as a public forest, shall at all times have the privilege of obtaining the advice, counsel and co-operation of the division of forestry in the department of conservation in the planting of trees, the marketing of timber, the prevention of fire, and in any matter that may pertain to the efficient maintenance of such public forests. If the cost of maintaining any such public forest shall at any time exceed the amount of revenue derived from such forest, such excess shall be paid out of the general fund of such county, city or town, as the case may be, in the same manner as other county, city or town expenses are paid. Acts 1929, p. 34, Sec. 8.

(Note: Acts 1929, p. 34, authorizes the board of commissioners of any county, the common council of any city, and the board of trustees of any incorporated town, to purchase or acquire by gift or devise, and to own, hold and maintain lands for a permanent public forest, upon petition to such board or council signed by not less than 51 per cent of the resident freeholders, etc. Provision is made for tax levy and bond issue.)

Sec. 36. Lands and Waters—Powers. The department of conservation shall have the following powers, duties and authority:

1. To have the care, custody, and control of the several preserves and parks owned by the state, other than the state forest reserves.

2. To make necessary rules and regulations to secure proper enforcement of the provisions of this act.

3. To prepare, print, post or distribute printed matter relating to the state parks and preserves.

4. Subject to the approval of the governor, to purchase lands for parks or preserves and scenic and historic places. For the purpose of acquiring lands for parks or preserves and scenic and historic places, the commission may exercise the right of eminent domain, in the manner hereinafter provided.

5. To receive and accept in the name of the people of the state by gift or devise, the fee or other estate therein of lands or scenic or historic places.

6. To employ, with the approval of the authorities having control of any state penal institution, the convicts committed to any such penal institution, for the purpose of producing or planting trees, clearing, improving, repairing, draining or developing lands purchased or acquired by the state for parks or as scenic or historic places.

7. To have the custody of all abstracts of title, papers, contracts or memoranda relating thereto, except original deeds to the state, for any lands purchased or received for parks or preserves or as scenic or historic purposes under the provisions of this section.

8. To investigate lakes and streams and springs of the state for the purpose of protecting them against impurities or pollution by industrial, municipal or other sewage waste. In case of existing pollution, it shall make investigation and report on the method of sewage purification and disposal and shall take such steps as it may deem necessary to prevent further pollution, except in such territory in this state

where sanitary districts have been created or may hereafter be created under existing law or amendment thereto and to execute the laws of this state and the rules and regulations of the commission issued thereunder, relative to the pollution of lakes, streams and springs.

9. To have general charge and supervision of the navigable waters of the state.

10. To issue permits to any person, firm or corporation to take coal, sand, gravel, stone, gas, oil or other mineral or substance from or under the bed of any of the navigable waters of the state. In issuing any such permit said department shall ascertain, find and determine, and shall fix by such permit, the area within which it shall be lawful and to the best interests of the state to permit the taking by the permittee of such coal, sand, gravel, stone, gas, oil, or other mineral or substance, or either of them; and shall charge, collect and receive a fee of fifty dollars for each permit so issued; and shall ascertain, find and determine, and shall fix by said permit, and charge and collect from the permittee when due, in addition to said fee, the amount of the reasonable value of the coal, sand, gravel, stone, gas, oil, mineral or substance to be taken, measured by weight, cubic dimensions, or other common and usual measurement. Such permit shall be upon and include the following conditions: That the permittee shall give bond in amount and with surety to the approval of the department for full and prompt compliance with the terms and conditions of the permit; that the permittee shall, monthly or quarterly, as the department may stipulate, make to the department a verified report and full account and payment for all such coal, sand, gravel, stone, gas, oil or other mineral or substance during the preceding month or quarter, as the case may be; that the department, at any time in reasonable hours, shall have the right to inspect all books, papers and records of the permittee relating to said account, and the right to inspect the works and workings of the permittee; that such permit may be revoked or suspended by the department for the failure or refusal of the permittee to comply with the provisions of this act or with the terms and conditions of such permit; that, subject to suspension or revocation, and subject to amendment or repeal of this act, the permit shall be and remain in force for such period as the department may determine, not to exceed five years from the date thereof: Provided, That said permit shall be renewable to permittee by written application filed with department six months prior to expiration of such permit; that the works, workings and operations under such permit shall not impede the navigation of such waters, nor injure, damage, impair, or endanger any bridge, highway, railroad, public work or utility, or the property of any riparian owner or adjoining proprietor or adjacent permittee, nor endanger the safety of the public or the lives of individuals; that the permittee shall use such means and take such measures, to be determined by the department and stipulated in the permit, as reasonably to prevent and avoid the impediment, injury, damage, impairment and danger mentioned in the last preceding condition. And the department may prescribe and stipulate such other reasonable conditions in such permit, consistent herewith, as

may be for the best interests of the state. All fees and moneys received by the department for and under such permits shall be covered into the state treasury as a part of the revolving fund of the division of lands and waters of said department, and shall be used and expended for the same purposes as other moneys in said revolving fund are used and expended. It shall be unlawful for any person, firm or corporation to take coal, sand, gravel, stone, gas, oil or other mineral or substance from or under the bed of any of the navigable waters of the state without first procuring and at the time having a permit therefor as herein provided. Whoever shall violate any provision of this section shall, on conviction, be fined in any sum not less than fifty dollars nor more than one thousand dollars, and each day's violation shall be deemed to constitute a separate and distinct offense. This section shall not modify, invalidate or revoke any permit heretofore issued by said department for the taking of coal, sand or gravel from or under any navigable waters, but all such permits shall be and remain in full force for the period and upon the terms prescribed therein. Acts 1929, p. 660, Sec. 1, amending Acts 1919, p. 375, Sec. 18.

Sec. 37. Lands and Waters—Town, City, Township or County Parks and Forests—Swamp, Saline or Meander Lands—Conveyance to Department of Conservation. Any incorporated town, city, township or town receiving land as provided in this act may convey and transfer the same to the department of conservation as, and for, a state park or a state forest, and the department of conservation shall have the authority to establish, develop, improve and maintain the same as other state parks and forests are improved and maintained, and also the authority to accept gifts, devises and bequests of any and all kinds of property of whatsoever nature for the enlargement, improvement, development, use and maintenance of the same. Acts 1929, p. 456, Sec. 8.

(Note: Acts 1929, p. 456, provides that any number of persons, associations or corporations, or any combination of such persons, associations or corporations together with any town, city, township or county, may purchase swamp, saline and meander lands owned by the state and bordering on lakes and streams for public park and forest purposes, by filing petition therefor in the circuit or superior court in the county in which such land is located. The act provides for certain court procedure, appraisement of the land, and the issuing of patents by the governor to towns, cities, townships and counties. Such towns, cities, townships and counties are authorized to establish, improve, develop and maintain such lands for parks and forests.)

II

Regulations of Conservation Commission

Sec. 38. Regulation Designating Certain Waters as Breeding Grounds for Mussels. Pursuant to the Act of the General Assembly approved March 11, 1927, the conservation commission of Indiana by this regulation and order hereby prescribes and designates respectively the following described areas and parts of waters of said state as breeding grounds for mussels, from which mussels shall not be taken for a period of five years from and including the first day of April, 1928, to-wit: 1. The Kankakee river from the Illinois-Indiana state line to the mouth of Sandy Hook ditch, in Newton and Jasper counties. 2. The St. Joseph river from the bridge at Mishawaka to the mouth of the Little Elkhart river, in St. Joseph and Elkhart counties. 3. The Tippecanoe river from its mouth to the east and west section line between sections 9 and 16 in township 26 north, range 3 west, in Tippecanoe, Carroll and White counties. 4. The Wabash river from the wagon bridge on state road 29 at Logansport to the county line between Miami and Wabash counties, in Cass and Miami counties. 5. The Wabash river from the Brown street bridge on state road 52 at Lafayette to the highway bridge at Attica, in Tippecanoe and Fountain counties. 6. The Wabash river from the Illinois-Indiana state line to the county line between Vigo and Vermillion counties, all in Vigo county. 7. White river from its mouth upstream to the Chicago & Eastern Illinois railroad bridge at Decker, all in Knox county. 8. The east fork of White river from its junction with the west fork upstream to the Hayesville bridge, in Daviess and Martin counties. 9. The east fork of White river from the highway bridge at Shoals upstream to the Williams dam, in Martin and Lawrence counties. 10. The east fork of White river from the bridge south of Bedford on state road 37 to the county line between Lawrence and Washington counties, all in Lawrence county. 11. The west fork of White river from the Edwardsport bridge to the mouth of Buck Creek ditch, the mouth of which ditch is about 3¾ miles upstream from the Daviess-Greene county line, in Daviess and Greene counties. 12. The west fork of White river from the Broad Ripple dam to the dam of the Northern Indiana Power Company at Riverwood, in Marion and Hamilton counties.

The taking of mussels from any of said areas and parts of said waters above prescribed and designated during the period herein above fixed is hereby and by said act of the General Assembly prohibited, under penalty as provided by said act. (Dated February 18, 1928.)

(Note: This regulation was promulgated pursuant to Acts 1927, p. 737. See Indiana Conservation Laws 1927, Secs. 198-204.)

Sec. 39. Regulation to Prevent the Spread and for the Suppression and Control of European Corn Borer. Whereas, an injurious insect, the European corn borer (Pyrausta nubilalis Hubn.), new to and not heretofore widely distributed, now exists in certain portions of the State of Indiana; and, whereas, in order to prevent the further spread of said insect and to suppress and control the same it is necessary, in the judgment of the conservation commission and of the state entomologist, to establish a quarantine and to make the following regulation in relation thereto; therefore, the conservation commission of the State of Indiana orders:

No corn or broom corn, including all parts of the stalk, or sorghums or Sudan grass (except the grain or seeds thereof when properly cleaned and when certified in writing as being clean by an officer or inspector of the United States department of agriculture) shall be moved, transported or carried from the area hereinafter designated.

The area herein quarantined is hereby designated as follows: All of Adams county; all of Allen county; all of Dekalb county; all of Elkhart county; all of Huntington county; all of Jay county; all of Kosciusko county; all of Lagrange county; all of Marshall county; all of Noble county; all of St. Joseph county; all of Steuben county; all of Wells county; all of Whitley county; the township of Liberty in Delaware county; the township of Newcastle in Fulton county; the township of Van Buren in Grant county; the townships of Cass, Center, Clinton, Cool Spring, Galena, Hanna, Hudson, Johnson, Kankakee, Lincoln, Michigan, New Durham, Noble, Pleasant, Prairie, Scipio, Springfield, Union, Washington and Wills in Laporte county; the townships of Franklin, Green, Greensfork, Jackson, Monroe, Stony Creek, Ward, Wayne and White River in Randolph county; the townships of Center, Davis, Jackson, North Bend, Oregon and Washington in Starke county; the townships of Chester, Noble, Lagro, PawPaw and Pleasant in Wabash county.

However, no restrictions are placed by this regulation on the movement, transportation or carriage of any article above mentioned entirely within the quarantined area as fixed by the United States department of agriculture for the states of Indiana, Michigan, Ohio, Pennsylvania, New York and West Virginia; nor on the movement, transportation or carriage of any such article into such quarantined area from points outside of said area; nor on the movement, transportation or carriage of any such article when it shall have been manufactured or processed in such manner as to eliminate all risk of carriage of the corn borer; nor of clean shelled corn, nor of clean seed of broom corn, when such shelled corn or seed of broom corn is certified in writing as being clean by an officer or inspector of the United States department of agriculture.

Corn, broom corn, sorghums and Sudan grass which originate outside of the area herein quarantined may be shipped or reshipped intrastate from the quarantined area to points outside such area under written permit from the state entomologist, but permits will be issued only for articles not infested with or exposed to infestation by the corn borer, and no person nor common carrier shall accept, move, transport or carry any such article out of the quarantined area unless each shipment is accompanied by such permit.

This regulation shall not apply to the movement, transportation, carriage or disposition of the enumerated articles by or for the department of conservation of Indiana or the United States department of agriculture for experimental or scientific purposes.

The violation of this regulation by any person or corporation shall be punishable by a fine as provided by the act creating a department of conservation, approved March 11, 1919.

This regulation to take effect April 6, 1929, and to remain in force and effect until revoked by the conservation commission.

(Note: This regulation supersedes the regulation of February 10, 1927. See Indiana Conservation Laws 1927, Sec. 307.)

(Note: The regulation of February 10, 1927, was held valid. Wallace v. Dohner, 165 N. E. 552. See Sec. 53 of this supplement.)

Sec. 40. Regulation to Prevent the Spread and for the Suppression and Control of European Corn Borer. Whereas, the department of conservation of Indiana has discovered the presence of European corn borer (Pyrausta nubilalis Hubn.) in certain places and areas of the State of Indiana; and, whereas, said department has declared certain townships in which such places and areas are located, and townships adjacent and contiguous thereto, to be infested areas; and, whereas, said corn borer is likely further to spread and communicate itself to other areas and townships; therefore, the department of conservation of Indiana, by the conservation commission, by this regulation orders:

That all corn stalks and parts, remnants and residues of corn stalks of each year's crop within any area which heretofore has been or hereafter may be declared by said department to be an infested area, shall by the owner or other person having charge of any such product or material or the farm or premises on which the same is located, be destroyed or treated before May first of the year succeeding the growth of that corn, by either or a combination of the following methods:

(a) By burning to total consumption by fire, or subjection of all portions of such product or material to sufficient heat to kill all living borers which may be included therein; or

(b) By snapping, raking and burning so as to leave not more than ten lineal feet of such product or material upon any square rod of land; or

(c) By tramping into and covering with manure to such depth that said product or material will be thoroughly heated; or

(d) By plowing under and by such regular or special field procedure, to the approval of the state entomologist, as will insure that between May first and July tenth of that year no portion of such product or material capable of harboring living corn borers shall appear on the surface of the field or land after it has been plowed, or disced, or harrowed, or planted, or cultivated.

If any owner or other person having charge of any such product, material, farm or premises, after having due notice from the department of conservation or its authorized agents to destroy or treat as aforesaid any such product or material, shall fail, refuse or neglect, within the time limit fixed in such notice, to destroy or treat such product or material in the manner above provided, in that event the department of conservation or its authorized agents will take the necessary action to destroy or treat such product or material, and the expense thereby incurred, or such portion thereof as said department may determine, shall be assessed against such farm or premises and certified to the county auditor for collection as state and county taxes are collected, as provided by law.

Provided, That the following materials need not be destroyed or treated as above required: Ear corn, husked and stored for grain; ensilage; corn fodder, finely shredded or finely ground; corn cobs or pieces of cobs, when not mixed with stalks or remnants or parts of stalks; corn stubble which has been cut to not more than four inches in height.

The violation of this regulation shall be punishable by fine, or by fine and imprisonment, as provided by law.

This regulation to take effect October 20, 1927, and to remain in force and effect until revoked by the department of conservation.

(Note: Validity of regulations, see Sec. 53 of this supplement.)

(Note: This regulation was promulgated pursuant to Acts 1927, p. 146. See Indiana Conservation Laws 1927, Secs. 298-305.)

III

Digest of Opinions of Attorney General

Sec. 41. Fish and Game—Wabash River—Mussel Licenses—Net Licenses. The thread or center of the Wabash river is the boundary line between the states of Indiana and Illinois where such river forms the boundary between said states, and the waters lying east of the center line of said river are waters of this state. The general assembly of Indiana is empowered to prescribe regulations for taking fish or mussels and mussel shells from that part of the river which is in Indiana. The act of 1927, page 737, requires licenses for all persons taking mussels or mussel shells on the Indiana side of the center of the Wabash river. All persons residing outside of Indiana must take out non-residents' licenses and parties residing in Indiana residents' licenses. Persons licensed by Indiana may take mussels only from the Indiana side. The construction or administration of the Illinois mussel law by Illinois authorities, in the absence of any provisions for reciprocal agreements between that state and Indiana, can have no effect on the construction or administration of the Indiana law. Op. Atty. Gen. 1927-1928, p. 229.

(See Secs. 48 and 49, Indiana Conservation Laws 1927.)

Sec. 42. Fish and Game—Selling Buildings on Brown County Game Reserve. The game reserve lands belong to the state for game reserve purposes and no part of them may be sold except such sale be first authorized by the legislature. If the department deems old and unneeded buildings an injury to the game reserve rather than a benefit, the department may lawfully clear the land of them by tearing them down and thereafter sell such part or all of the materials as are not deemed needed for the purposes of the game reserve, such materials being treated by the department as it is authorized to treat dead timber or other refuse found obstructing the proper development of the game reserve. Op. Atty. Gen. 1927-1928, p. 231.

Sec. 43. Fish and Game—Possession of Fish—Close Season. Section 29, Acts 1927, p. 93, is to be construed as prohibiting the possession, during the close season, of fish of the species mentioned, regardless of where and when they may have been caught. The reasons for such an interpretation are, first, the plain language of the statute, and second, the ease with which the law might be evaded if it were construed as applying only to fish caught within the state. Said section is not such a regulation of interstate commerce as to be invalid. The title of the act is sufficient to cover the offense of "possession." Op. Atty. Gen. 1927-1928, p. 235.

(Note: Sec. 29, Acts 1927, p. 93, was amended by Acts 1929, p. 323, by making it apply only to fish "native of this state." See Sec. 12 of this supplement. Said Sec. 29 is Sec. 170 of Indiana Conservation Laws, 1927.)

Sec. 44. Forestry—Classified Land—Partition Fence. Land classified as forestry land under Acts 1921, p. 567, and assessed at $1 per acre, is not governed by the provisions of the partition fence statute, Acts 1911, p. 515. The latter act contains a proviso that "this section shall not apply to any land whose assessed value is five dollars or less per acre or exempt from taxation." The owners of land assessed at no more than $5 per acre are not required to build or maintain partition fences. Op. Atty. Gen. 1927-1928, p. 232.

Sec. 45. Lands and Waters—State Parks—Lands Acquired by Counties—Condemnation. If county commissioners proceed to acquire land to be turned over to the state under the provisions of chapter 174, Acts 1927, which requires the consent of the governor and director of the department of conservation, after such consent by the state, the state might bring eminent domain proceedings if the commissioners do not succeed in purchasing the land. It would be well if said chapter 174 were amended to give the commissioners the power of eminent domain. Op. Atty. Gen. 1927-1928, p. 233.

Sec. 46. Lands and Waters—Wabash River—Low Water Mark—Permits to Take Sand and Gravel. The permit to the New Harmony Gravel Company is "to take sand and gravel from and under the bed of the Wabash river within the low water mark thereof" within a certain described area. It appears that a controversy has arisen between a riparian owner and the permittee as to where the low water mark is at a certain point in said area, and that such riparian owner has forbidden the permittee to take sand and gravel outside of what he contends is the low water mark. The question is solely between the permittee and the riparian owner. The permit issued by the department of conservation does not undertake to designate where the low water mark of the river is and there is no obligation on it to establish the low water mark. The legal procedure would be a suit by the riparian owner against the permittee to enjoin the latter from taking sand and gravel from the point in dispute. In such a suit the court would determine the fact as to where the low water mark is at such point. The question of fact to determine is, where was the low water mark of the stream when the waters flowed over the old bed before the stream established a cut-off at the loop shown by the accompanying map. The present dispute does not involve the rights of the state, and should be left to those whose rights are being affected. Op. Atty. Gen. 1927-1928, p. 233.

Sec. 47. Entomology—Corn Borer—Money Received by Department for Corn Raised on an Experimental Station. Section 6 of the corn borer act, Acts 1927, p. 146, appropriates money to the department of conservation to be expended if necessary by the division of entomology for the control and eradication of European corn borer, etc. It is provided that such appropriation would not revert to the state treasury at the end of the fiscal year but might be used to carry on the work in the succeeding year. No provisions are made in the statute for any receipts of money by the department and it appears that no such receipts were contemplated. A check for $247.50 was paid to the department for the sale of some corn which was raised on a farm operated as an experimental station in connection with efforts to eradicate such pests. It is not money appropriated, but has come to the department as an incident to the work. There being no statute authorizing the use of such money or adding it to the appropriation, it should be paid into the state's general fund. Op. Atty. Gen. 1927-1928, p. 234.

IV

Digest of Court Decisions

Sec. 48. Fish and Game—Game Wardens—Arrests. In a prosecution against a game warden for assault and battery with intent, an instruction defining the crime but omitting to state that the touching must be "unlawful," was erroneous. It was particularly prejudicial to the warden because the nature of his duties as a peace officer makes necessary aggressive acts which may be lawful when performed by an officer in making an arrest but which would be unlawful if performed by a private individual. Durham v. State, 159 N. E. 145.

Sec. 49. Fish and Game—Game Wardens—Arrests. The usual rules of law as to self defense are applicable to an arresting officer. An officer may, of course, defend himself like any other person who is assaulted. But the law does not stop there, but throws around him a special protection because he must of necessity press forward and accomplish his object. In a prosecution against a game warden for assault and battery with intent, an instruction that before defendant can exercise the right of self defense he must be free from fault, and if by his own unauthorized acts he brought the assault upon himself then he cannot claim self defense, was erroneous in the absence of further instructions as to the law applicable to the exercise of self defense by an arresting officer. The acts of the officer in seeking to prevent the accused's escape could not be considered as "his own unauthorized act," but on the contrary were acts expressly required of him by law. Durham v. State, 159 N. E. 145.

Sec. 50. Fish and Game—Game Wardens—Arrests. In a prosecution against a game warden for assault and battery with intent by shooting in making an arrest, an instruction that if the misdemeanant resisted arrest, the warden would not be authorized to use such force and instrumentalities as would imperil the life of the misdemeanant in order to overcome his resistance and that human life is too precious to be imperiled by the arrest of one who is only guilty of a misdemeanor, and that appellant, in order to overcome such resistance, used a dangerous and deadly weapon in such manner as to endanger life and thereby inflict serious wounds, then appellant would be guilty of assault and battery at least, was erroneous. The general rules of law are: (a) That an officer having the right to arrest a misdemeanant may use all the force reasonably necessary to accomplish the arrest, except (b) that he may not, merely for the purpose of effecting the arrest, kill or inflict great bodily harm endangering the life of the misdemeanant; thus an officer may not kill or shed blood in attempting to arrest a misdemeanant who is fleeing, but not resisting. (c) That if the misdemeanant physically resists, the officer need not retreat, but may press forward and repel the resistance with such force, short of taking life, as is necessary to effect the arrest; and if in so doing the officer is absolutely obliged to seriously wound or take the life of the accused, in order to prevent the accused from seriously wounding or killing him, he will be justified. To adopt the rule stated in the instruction would be to paralyze the strong arm of the law and render the state powerless to use extreme force when extreme resistance is offered and would permit misdemeanants to stay the power of the state by unlawful resistance. Durham v. State, 159 N. E. 145.

Sec. 51. Fish and Game—Law Observance. Many acts which are not inherently wrong and involve no moral turpitude, have been made unlawful by statutes enacted in the interest of the welfare of the public or state, or for the conservation of its natural resources. The law against seining fish is such a law and respect for our government and its authority requires that a citizen obey the law. It is a narrow attitude and one that is dangerous to our country for those who may feel that their personal rights and liberties have been wrongfully curtailed by legislation to seek to nullify the law by violation thereof and by defying constituted legal authority when placed under arrest. Durham v. State, 159 N. E. 145.

Sec. 52. Fish and Game—Use of Explosives. Affidavit was sufficient which alleged substantially the offense defined by statute, though it further alleged that said dynamite was not then and there put into the said waters for mining or mechanical purposes, "but was so placed with intent then and there and thereby to cause the same to explode within said waters, for the unlawful purpose and with the unlawful intent thereby to kill and injure the fish in said water." The quoted phrase was not surplusage, but was, in effect, a denial of the authorized use of dynamite. It did not prejudice the substantial rights of appellants. It did not inject into the affidavit an independent or collateral fact improper for the jury to consider. The pleader having alleged the fact in question, he assumed the burden of proving it. "According to the statute, the legislature evidently had in mind practices in the use of dynamite in the waters of this state which it sought to prohibit. It knew and we know from common knowledge that fish is the principal life of such waters, and that explosions from dynamite are exceedingly destructive of such life. So that the legislature, in order to stop this evil, placed these waters, as to explosives, under the supervision of the commissioner of fisheries and game. That fact alone is very persuasive of the legislative thought, and its one purpose at least was to protect the fish from the wanton and disastrous results from the use of dynamite or other explosives."

"We have read the evidence recited in their (appellants') brief, without being able to select a single ultimate fact not supported by evidence." Voyles v. State, 165 N E. 322.

Sec. 53. Entomology—Corn Borer—Regulations. Appellees, in the spring and summer of 1926, produced on their farm a crop of corn which became infested with corn borer. In February, 1927, the conservation department promulgated a regulation by which certain sections of the state, including appellees' farm, were placed under quarantine. The regulation provided, among other things, that before May 1 all corn within an infested area shall be cut within three inches of the ground, or standing stalks or higher stubble shall be snapped at the ground line, raked and burned or completely buried by plowing under, by the respective owners, and all corn stalks within an infested area shall be disposed of by said owners by ensilage, shredding, burning or completely buried by plowing under. In April, 1927, appellees planted oats and barley in the same field which had been planted in corn the previous year, and in so doing many corn stalks were, in violation of the order, left upon the surface of the field. Appellants, the state entomologist and his assistant, conferred with appellees and made threats to enter upon the land for the purpose of destroying the infested stalks if the owners did not at once comply with the order. Thereupon appellees commenced this suit to enjoin appellants from entering upon the land. From a judgment for appellees, appellants appeal. Reversed. Held: The conservation act of 1919 is within the police power of the state and is constitutional. Rules and regulations, when adopted by an administrative body in accordance with the provisions of the act by which the administrative body was created, are in effect a part of the statute. A regulation to be valid must be reasonable and within the authority delegated by the statute. The facts shown by the evidence show there was an emergency which justified action on the part of the officers, and the corn borer regulation was reasonable and within the authority delegated by statute. Appellants had the right to go upon appellees' land and upon the growing crops for the purpose of enforcing the regulation. Wallace v. Dohner, 165 N. E. 552.

(Corn borer regulations, see Secs. 39 and 40 of this supplement.)

V

Federal Statutes

Sec. 54. Migratory Bird Conservation Act. This act shall be known by the short title of "Migratory Bird Conservation Act." Public, No. 770, 70th Congress, Sec. 1.

Sec. 55. Migratory Bird Conservation Act. That a commission to be known as the migratory bird conservation commission, consisting of the secretary of agriculture, as chairman, the secretary of commerce, the secretary of the interior, and two members of the Senate, to be selected by the president of the Senate, and two members of the House of Representatives, to be selected by the speaker, is hereby created and authorized to consider and pass upon any area of land, water, or land and water that may be recommended by the secretary of agriculture for purchase or rental under this act, and to fix the price or prices at which such area may be purchased or rented; and no purchase or rental shall be made of any such area until it has been duly approved for purchase or rental by said commission. Any member of the House of Representatives who is a member of the commission, if re-elected to the succeeding Congress, may serve on the commission notwithstanding the expiration of a Congress. Any vacancy on the commission shall be filled in the same manner as the original appointment. The ranking officer of the branch or department of a state, to which is committed the administration of its game laws, or his authorized representative, and in a state having no such branch or department, the governor thereof, or his authorized representative, shall be a member ex officio of said commission for the purpose of considering and voting on all questions relating to the acquisition, under this act, of areas in his state. Public, No. 770, 70th Congress, Sec. 2.

Sec. 56. Migratory Bird Conservation Act. That the commission hereby created shall, through its chairman, annually report in detail to Congress, not later than the first Monday in December, the operations of the commission during the preceding fiscal year. Public, No. 770, 70th Congress, Sec. 3.

Sec. 57. Migratory Bird Conservation Act. That the secretary of agriculture shall recommend no area for purchase or rental under the terms of this act except such as he shall determine is necessary for the conservation of migratory game birds. Public, No. 770, 70th Congress, Sec. 4.

Sec. 58. Migratory Bird Conservation Act. That the secretary of agriculture is authorized to purchase or rent such areas as have been approved for purchase or rental by the commission at the price or prices fixed by said commission, and to acquire by gift or devise, for use as inviolate sanctuaries for migratory birds, areas which he shall determine to be suitable for such purposes, and to pay the purchase or rental price and expenses incident to the location, examination, and survey of such areas and the acquisition of title thereto, including options when deemed necessary by the secretary of agriculture, from moneys to be appropriated hereunder by Congress from time to time: Provided, That no lands acquired, held, or used by the United States for military purposes shall be subject to any of the provisions of this act. Public, No. 770, 70th Congress, Sec. 5.

Sec. 59. Migratory Bird Conservation Act. That the secretary of agriculture may do all things and make all expenditures necessary to secure the safe title in the United States to the areas which may be acquired under this act, but no payment shall be made for any such areas until the title thereto shall be satisfactory to the attorney general, but the acquisition of such areas by the United States shall in no case be defeated because of rights of way, easements, and reservations which, from their nature, will in the opinion of the secretary of agriculture in no manner interfere with the use of the areas so encumbered for the purposes of this act; but such rights of way, easements, and reservations retained by the grantor or lessor, from whom the United States receives title, shall be subject to rules and regulations prescribed from time to time by the secretary of agriculture for the occupation, use, operation, protection, and administration of such areas as inviolate sanctuaries for migratory birds; and it shall be expressed in the deed or lease that the use, occupation, and operation of such rights of way, easements, and reservations shall be subordinate to and subject to such rules and regulations. Public, No. 770, 70th Congress, Sec. 6.

Sec. 60. Migratory Bird Conservation Act. That no deed or instrument of conveyance shall be accepted by the secretary of agriculture under this act unless the state in which the area lies shall have consented by law to the acquisition by the United States of lands in that state. Public, No. 770, 70th Congress, Sec. 7.

Sec. 61. Migratory Bird Conservation Act. That the jurisdiction of the state, both civil and criminal, over persons upon areas acquired under this act shall not be affected or changed by reason of their acquisition and administration by the United States as migratory bird reservations, except so far as the punishment of offenses against the United States is concerned. Public, No. 770, 70th Congress, Sec. 8.

Sec. 62. Migratory Bird Conservation Act. That nothing in this act is intended to interfere with the operation of the game laws of the several states applying to migratory game birds in so far as they do not permit what is forbidden by federal law. Public, No. 770, 70th Congress, Sec. 9.

Sec. 63. Migratory Bird Conservation Act. That no person shall knowingly disturb, injure, or destroy any notice, signboard, fence, building, ditch, dam, dike embankment, flume, spillway, or other improvement or property of the United States on any area acquired under this act, or cut, burn, or destroy any timber, grass, or other natural growth on said area or on any area of the United States which heretofore has been or which hereafter may be set apart or preserved for the use of the department of agriculture as a game refuge or as a preserve or reservation and breeding ground for native birds under any law, proclamation, or executive order, or occupy or use any part thereof, or enter thereon for any purpose, except in accordance with regulations of the secretary of agriculture; nor shall any person take any bird or nest or egg thereof on any area acquired under this act, except for scientific or propagating purposes under permit of the secretary of agriculture; but nothing in this act or in any regulation thereunder shall be construed to prevent a person from entering upon any area acquired under this act for the purpose of fishing in accordance with the law of the state in which such area is located: Provided, That such person complies with the regulations of the secretary of agriculture covering such area. Public, No. 770, 70th Congress, Sec. 10.

Sec. 64. Migratory Bird Conservation Act. That for the purposes of this act migratory birds are those defined as such by the treaty between the United States and Great Britain for the protection of migratory birds concluded August 16, 1916. Public, No. 770, 70th Congress, Sec. 11.

Sec. 65. Migratory Bird Conservation Act. For the acquisition, including the location, examination, and survey of suitable areas of land, water, or land and water for use as migratory bird reservations, and necessary expenses incident thereto, and for the administration, maintenance, and development of such areas and other preserves, reservations, or breeding grounds frequented by migratory game birds, and under the administration of the secretary of agriculture, including the construction of dams, dikes, ditches, flumes, spillways, buildings, and other necessary improvements, and for the elimination of the loss of migratory birds from alkali poisoning, oil pollution of waters, or other causes, for co-operation with local authorities in wild life conservation, for investigations and publications relating to North American birds, for personal services, printing, engraving, and issuance of circulars, posters, and other necessary matter, and for the enforcement of the provisions of this act there are authorized to be appropriated, in addition to all other amounts authorized by law to be appropriated, the following amounts for the fiscal years specified:

$75,000 for the fiscal year ending June 30, 1930;

$200,000 for the fiscal year ending June 30, 1931;

$600,000 for the fiscal year ending June 30, 1932;

$1,000,000 for the fiscal year ending June 30, 1933;

$1,000,000 for each fiscal year thereafter for a period of six years; and

$200,000 for the fiscal year ending June 30, 1940, and for each fiscal year thereafter. Not more than 20 per centum of the amounts appropriated pursuant to this authorization for the fiscal year beginning July 1, 1930, and for each fiscal year to and including the fiscal year ending

June 30, 1939, shall be expended for personal services in the District of Columbia and elsewhere incident to the administration and maintenance of acquired areas, printing, engraving, and issuance of circulars and posters. No part of any appropriation authorized by this section shall be used for payment of the salary, compensation, or expenses of any United States game protector, except reservation protectors for the administration, maintenance, and protection of such reservations and the birds thereon: Provided, That reservation protectors appointed under the provisions of this act shall be selected, when practicable, from qualified citizens of the state in which they are to be employed. The secretary of agriculture is authorized and directed to make such expenditures and to employ such means, including personal services in the District of Columbia and elsewhere, as may be necessary to carry out the foregoing objects. Public, No. 770, 70th Congress, Sec. 12.

Sec. 66. Migratory Bird Conservation Act. That for the efficient execution of this act the judges of the several courts established under the laws of the United States, United States commissioners, and persons appointed by the secretary of agriculture to enforce this act shall have, with respect thereto, like powers and duties as are conferred by section 5 of the migratory bird treaty act (title 16, section 706 of the United States Code) upon said judges, commissioners, and employes of the department of agriculture appointed to enforce the act last aforesaid. Any bird, or part, nest or egg thereof taken or possessed contrary to this act, when seized, shall be disposed of as provided by section 5 of said migratory bird treaty act. Public, No. 770, 70th Congress, Sec. 13.

Sec. 67. Migratory Bird Conservation Act. That any person, association, partnership, or corporation who shall violate or fail to comply with any of the provisions of this act shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be fined not less than $10 nor more than $500, or be imprisoned not more than six months, or both. Public, No. 770, 70th Congress, Sec. 14.

Sec. 68. Migratory Bird Conservation Act. That for the purposes of this act the word "take" shall be construed to mean pursue, hunt, shoot, capture, collect, kill, or attempt to pursue, hunt, shoot, capture, collect, or kill, unless the context otherwise requires. Public, No. 770, 70th Congress, Sec. 15.

Sec. 69. Migratory Bird Conservation Act. Nothing in this act shall be construed as authorizing or empowering the migratory bird conservation commission herein created, the secretary of agriculture, or any other board, commission, or officer to declare, withdraw, or determine, except heretofore designated, any part of any national forest or power site, a migratory bird reservation under any of the provisions of this act, except by and with the consent of the legislature of the state wherein such forest or power site is located. Public, No. 770, 70th Congress, Sec. 16.

Sec. 70. Migratory Bird Conservation Act. That when any state shall, by suitable legislation, make provision adequately to enforce the provisions of this act, and all regulations promulgated thereunder, the secretary of agriculture may so certify, and then and thereafter said state may co-operate with the secretary of agriculture in the enforcement of this act and the regulations thereunder. Public, No. 770, 70th Congress, Sec. 17.

Sec. 71. Migratory Bird Conservation Act. That a sum sufficient to pay the necessary expenses of the commission and its members, not to exceed an annual expenditure of $5,000, is hereby authorized to be appropriated out of any money in the treasury not otherwise appropriated. Said appropriation shall be paid out on the audit and order of the chairman of said commission, which audit and order shall be conclusive and binding upon the general accounting office as to the correctness of the accounts of said commission. Public, No. 770, 70th Congress, Sec. 18.

Sec. 72. Migratory Bird Conservation Act. That if any provision of this act or the application thereof to any person or circumstance is held invalid the validity of the remainder of the act and of the application of such provisions to other persons and circumstances shall not be affected thereby. Public, No. 770, 70th Congress, Sec. 19.

Sec. 73. Migratory Bird Conservation Act. That this act shall take effect upon its passage and approval. (Approved February 18, 1929.) Public, No. 770, 70th Congress, Sec. 20.

VI

Federal Regulations

Sec. 74. Means by Which Migratory Birds May Be Taken—Regulation 3. The migratory game birds specified in regulation 4 hereof may be taken during the open season with a gun only, not larger than No. 10 gauge, fired from the shoulder, except as specifically permitted by regulations 7, 8, 9, and 10 hereof; they may be taken during the open season from the land and water, with the aid of a dog, the use of decoys, and from a blind or floating device; but nothing herein shall be deemed to permit the use of an automobile, airplane, powerboat, sailboat, any boat under sail, any floating device towed by powerboat or sailboat, or any sinkbox (battery), except that sinkboxes (batteries) may be used in the taking of migratory waterfowl in coastal sounds and bays (including Back Bay, Princess Anne county, State of Virginia), and other coastal waters; and nothing herein shall be deemed to permit the use of an airplane, or a powerboat, sailboat, or other floating device for the purpose of concentrating, driving, rallying, or stirring up migratory waterfowl. (As amended April 23, 1929.)

(This amends the former regulation, Sec. 112 of Indiana Conservation Laws 1927.)

Sec. 75. Migratory Game Birds—Open Seasons—Regulation 4. For the purpose of this regulation each period of time herein prescribed as an open season shall be construed to include the first and last days thereof.

Waterfowl (except wood duck, eider ducks, and swans), rails, coot, gallinules, woodcock, Wilson snipe or jacksnipe, and mourning doves may be taken each day from half an hour before sunrise to sunset during the open seasons prescribed therefor in this regulation by the means and in the numbers permitted by regulations 3 and 5 hereof, respectively, and when so taken may be possessed any day in any state, territory, or district during the period constituting the open season where killed and for an additional period of 10 days next succeeding said open season, but no such bird shall be possessed in a state, territory, or district at a time when such state, territory, or district prohibits the possession thereof.

Waterfowl (except wood duck, eider ducks, and swans), coot, and Wilson snipe or jacksnipe. The open seasons for waterfowl (except wood duck, eider ducks, and swans), coot, and Wilson snipe or jacksnipe shall be as follows:

In Maine, New Hampshire, Vermont, Massachusetts (except in Nantucket and Dukes counties, and Barnstable county south and east of the cape Cod canal), Ohio, West Virginia, Michigan, Wisconsin, Minnesota, Iowa, North Dakota, South Dakota, Nebraska, Kansas, Colorado, Wyoming, Montana, Nevada, and that portion of Idaho comprising the counties of Boundary, Bonner, Kootenai, Benewah, and Shoshone and that portion of Washington lying east of the summit of the Cascade Mountains, the open season shall be from September 16 to December 31;

In New York (except Long Island), Illinois and Missouri the open season shall be from September 24 to January 7;

In that portion of Massachusetts known as Nantucket and Dukes counties, and Barnstable county south and east of the Cape Cod canal, and in Rhode Island, Connecticut, Pennsylvania, Indiana, Utah, Idaho (except in the counties of Boundary, Bonner, Kootenai, Benewah, and Shoshone), California, Oregon, and that portion of Washington lying west of the summit of the Cascade Mountains, the open season shall be from October 1 to January 15;

In that portion of New York known as Lond Island, and in New Jersey, Delaware, Oklahoma, New Mexico, Arizona, that portion of Texas lying west and north of a line beginning on the Rio Grande river directly west of the town of Del Rio, Texas; thence east to the town of Del Rio; thence easterly following the center of the main track of the Southern Pacific Railroad through the towns of Spofford, Uvalde, and Hondo; thence to the point where the Southern Pacific Railroad crosses the I. & G. N. R. R., at or near San Antonio; thence following the center of the track of said I. G N. R. R., in an easterly direction, to the point in the city of Austin, where it joins Congress avenue, near the I. & G. N. R. R. depot; thence across said Congress avenue to the center of the main track of the H. & T. C. R. R., where said track joins said Congress avenue, at or near the H. & T. C. R. R. depot; thence following the center line of the track of said H. & T. C. R. R. in an easterly direction through the towns of Elgin, Giddings, and Brenham to the point where said railroad crosses the Brazos river; thence with the center of said Brazos river in a general northerly direction to the point on said river where the Beaumont branch of the Santa Fe Railway crosses the same; thence with the center of the track of the said G. C. & S. F. R. R., in an easterly direction, through the towns of Navasota, Montgomery, and Conroe to the point at or near Cleveland, where said G. C. & S. F. R. R. crosses the Houston, East and West Texas Railroad; thence with the center of said H. E. & W. T. R. R. track to the point in said line, where it strikes the Louisiana line, the open season shall be from October 16 to January 31; and in that portion of Texas lying south and east of the line above described the open season shall be from November 1 to January 31;

In Maryland, the District of Columbia, Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Arkansas, and Louisiana the open season shall be from November 1 to January 31; and

In Alaska the open season shall be from September 1 to December 15.

Rails and gallinules (except coot).—The open season for sora and other rails and gallinules (except coot) shall be from September 1 to November 30, except as follows:

In Massachusetts the open season shall be from September 16 to December 15; and

In Louisiana the open season shall be from November 1 to January 31.

Woodcock.—The open seasons for woodcock shall be as follows:

In Maine, New Hampshire, Vermont, New York, and North Dakota the open season shall be from October 1 to October 31;

In Massachusetts, Rhode Island, and Connecticut the open season shall be from October 20 to November 19;

In New Jersey, Pennsylvania, Ohio, Indiana, Michigan, Wisconsin, and Iowa the open season shall be from October 15 to November 14;

In Maryland, the District of Columbia, and Missouri the open season shall be from November 10 to December 10;

In Delaware, Virginia, West Virginia, Kentucky, Arkansas, and Oklahoma the open season shall be from November 15 to December 15; and

In North Carolina, South Carolina, Georgia, Alabama, Mississippi, and Louisiana the open season shall be from December 1 to December 31.

Doves.—The open seasons for mourning doves shall be as follows:

In New Jersey, Pennsylvania, Ohio, Indiana, Michigan, Wisconsin, and Iowa the open season shall be from October 15 to November 14;

In Delaware, Maryland, Virginia, Tennessee, Kentucky, Ohio, Indiana, Illinois, Minnesota, Nebraska, Kansas, Missouri, Arkansas, Oklahoma, New Mexico, Colorado, Utah, Arizona, California, Nevada, Idaho, Oregon, that portion of Texas lying west and north of a line beginning on the Rio Grande river directly west of the town of Del Rio, Texas; thence east to the town of Del Rio; thence easterly following the center of the main track of the Southern Pacific Railroad through the towns of Spofford, Uvalde, and Hondo; thence to the point where the Southern Pacific Railroad crosses the I. & G. N. R. R., at or near San Antonio; thence following the center of the track of said I. & G. N. R. R., in an easterly direction, to the point in the city of Austin, where it joins Congress avenue, near the I. & G. N. R. R. depot; thence across said Congress avenue to the center of the main track of the H. & T. C. R. R., where said track joins said Congress avenue, at or near the H. & T. C. R. R. depot; thence following the center line of the track of said H. & T. C. R R. in an easterly direction through the towns of Elgin, Giddings, and Brenham to the point where said railroad crosses the Brazos river; thence with the center of said Brazos river, in a general northerly direction, to the point on said river where the Beaumont branch of the Sante Fe Railway crosses the same; thence with the center of the track of the said G. C. & S. F. R. R., in an easterly direction, through the towns of Navasota, Montgomery, and Conroe to the point at or near Cleveland, where said G. C. & S. F. R. R. crosses the Houston, East and West Texas Railroad; thence with the center of said H. E. & W. T. R. R. track to the point in said line where it strikes the Louisiana line, the open season shall be from September 1 to December 15; and in that portion of Texas lying south and east of the line above described the open season shall be from November 1 to December 31;

In South Carolina, Georgia, Florida, Alabama, (except in Mobile and Baldwin counties), Mississippi, and Louisiana the open season shall be from September 1 to September 30 and from November 20 to January 31;

In that portion of Alabama known as Mobile and Baldwin counties the open season shall be from November 1 to January 31; and

In North Carolina the open season shall be from November 20 to January 31.

(As amended April 23, 1929.)

(This amends the former regulation, Sec. 113 of Indiana Conservation Laws 1927.)

Sec. 76. Migratory Birds—Scientific Permits—Taxidermists' Permits—Regulation 9. A person may take in any manner and at any time migratory birds and their nests and eggs for scientific purposes when authorized by a permit issued by the secretary, which permit shall be carried on his person when he is collecting specimens thereunder and shall be exhibited to any person requesting to see the same, except that nothing herein shall be deemed to permit the taking of any migratory game bird on any day from sunset to one-half hour before sunrise.

Application for a permit must be addressed to the secretary of agriculture, Washington, D. C., and must contain the following information: Name and address of applicant, his age, and name of state, territory or district in which specimens are proposed to be taken, and the purpose for which they are intended. Each application shall be accompanied by two certificates certifying to the fitness of such person to hold a federal permit. These certificates will be accepted from well-known ornithologists, principals or superintendents of educational or zoological institutions, officials or members of zoological, natural history, or other scientific organizations, or instructors in zoology in high schools, colleges, or universities, or by any one of the above together with a certificate by the chief game official of the state in which the applicant is a resident or of the state in which he desires to conduct his operations.

The permit may limit the number and species of birds, birds' nests, or eggs that may be collected thereunder, and may authorize the holder thereof to possess, buy, sell, exchange, and transport in any manner and at any time migratory birds, parts thereof, and their nests and eggs for scientific purposes; or it may limit the holder to one or more of these privileges. Public museums, zoological parks and societies, and public, scientific, and educational institutions may possess, buy, sell, exchange and transport in any manner and at any time migratory birds and parts thereof and their nests and eggs for scientific purposes without a permit, but no specimens shall be taken without a permit. The plumage and skins of migratory game birds legally taken may be possessed and transported by a person without a permit.

A taxidermist, when authorized by a permit issued by the secretary, may possess, buy, sell, exchange, and transport in any manner and at any time migratory birds and parts thereof legally taken, or he may be limited to one or more of these privileges. A taxidermist granted a permit under this regulation shall keep books and records correctly setting forth the name and address of each person delivering each specimen of a migratory bird to him together with the name of each species, the date of delivery, the disposition of such specimen, and the date thereof, which said books and records shall be available for inspection at all reasonable hours on request by any duly authorized representative of the department of agriculture.

Each permit shall be valid until revoked by the secretary unless otherwise specified therein, shall not be transferable, and shall be revokable at the discretion of the secretary. A permit duly revoked by the secretary shall be surrendered to him by the person to whom it was issued, on demand of any employee of the United States department of agriculture duly authorized to enforce the provisions of the migratory bird treaty act.

A person holding a permit under this regulation shall report annually to the secretary on or before the 10th day of January during the life of the permit the number of skins, nests, or eggs of each species collected, bought, sold, received, possessed, mounted, exchanged, or transported during the preceding calendar year.

Every package in which migratory birds or their nests or eggs are transported shall have clearly and conspicuously marked on the outside thereof the name and address of the sender, the number of the permit in every case when a permit is required, the name and address of the consignee, a statement that it contains specimens of birds, their nests, or eggs for scientific purposes, and, whenever such a package is transported or offered for transportation from the Dominion of Canada into the United States or from the United States into the Dominion of Canada, an accurate statement of the contents. (As amended April 23, 1929. This amends the former regulation, Sec. 118 of Indiana Conservation Laws, 1927.)

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THE GEOLOGICAL HISTORY OF THE VERTEBRATES OF INDIANA

and

Their Position in the Ancient North American Fauna

By Roy L. Moodie

DIVISION OF GEOLOGY
W. N. LOGAN, State Geologist

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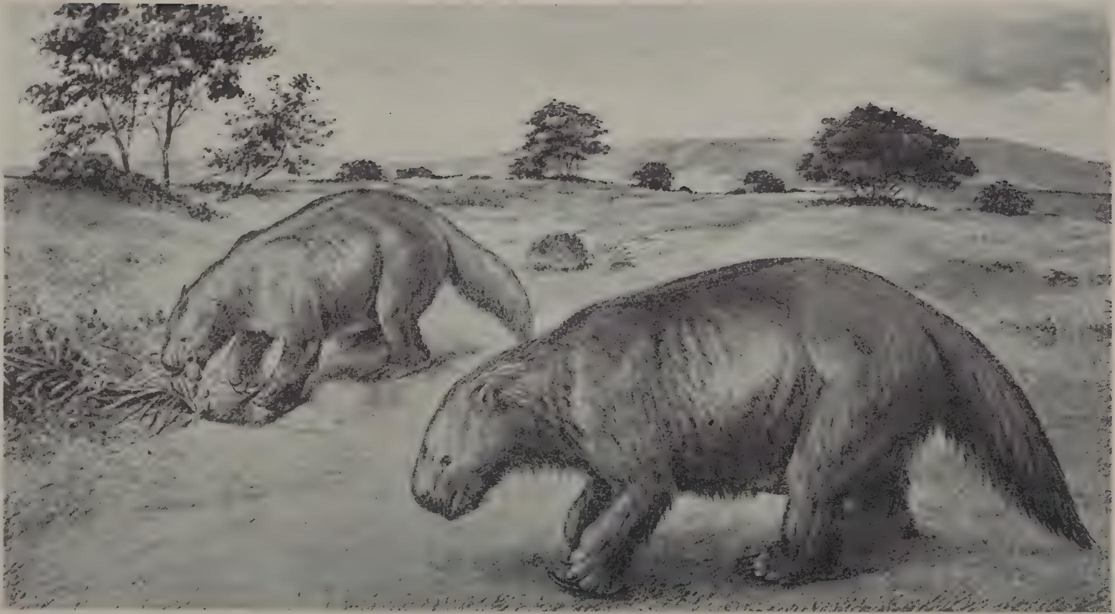

Restoration of one species of the ancient giant ground sloths (Mylodon harlani) as it probably looked in life. Under the heavy coat of stiff hair was a thick layer of fat containing a very great number of small bones which served as a protection against the attacks of carnivorous enemies. Although the mylodonts were doubtless sluggish and slow, yet it seems probable that a terrible wound could be made with their huge claws. The mylodonts were plant feeders, browsing off the leaves of shrubs and trees, as well as on succulent annuals. Representative specimens are found widely scattered throughout the United States. The painting, by John L. Ridgway, is based on abundant remains secured from the "Tar Pits" of the Rancho la Brea, at Los Angeles.

Courtesy of the Los Angeles Museum.

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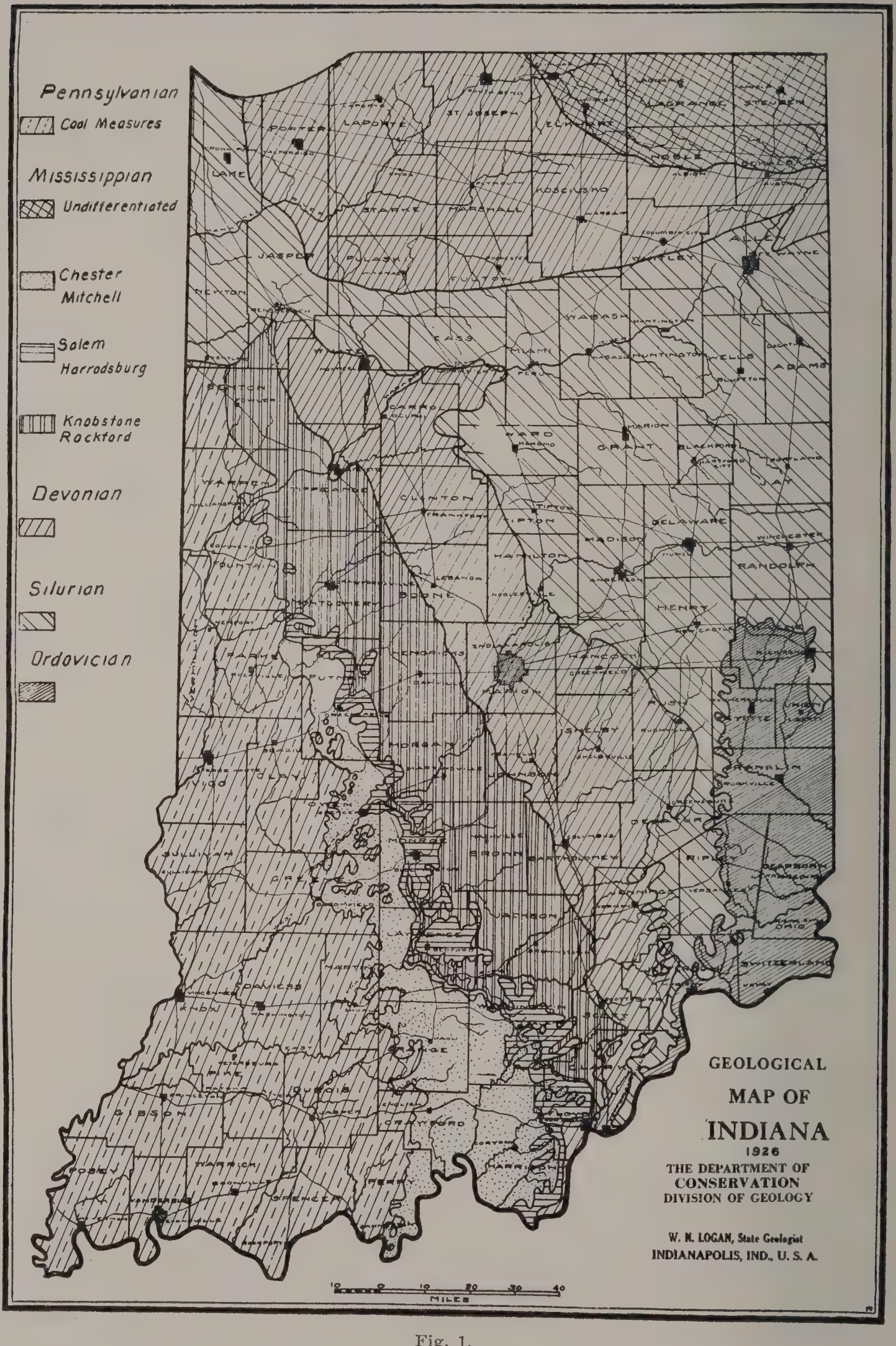
Pennsylvanian
Coal Measures
Mississippian
Undifferentiated
Chester
Mitchell
Salem
Harrodsburg
Knobstone
Rockford
Devonian
Silurian
Ordovician
GEOLOGICAL
MAP OF
INDIANA
1926
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DIVISION OF GEOLOGY
W. N. LOGAN, State Geologist
INDIANAPOLIS, IND., U. S. A.
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MILES

Fig. 1.

INTRODUCTION

The following pages give, in a brief, non-technical form, accounts of the development of the vertebrate groups throughout all geological time, with local application of the relation of the fossil vertebrates as they have been discovered in the rocks of Indiana. This covers a period of discovery of more than three-quarters of a century. An important Devonian fish was described from Indiana in 1846 and this still remains an outstanding discovery in vertebrate paleontology.

Since the fossil vertebrates of Indiana only sketch here and there important paleontological events, we must go to the surrounding regions and even to distant countries to secure the evidences we need to tell the complete story. Modern political boundaries are of no importance in controlling the activities of Mother Nature. All paleontological knowledge has been scrutinized and that part pertaining to Indiana and its environs has been given prominence.

The fossil vertebrates which have been found in the rocks of Indiana are widely scattered. Some have been lost. Such is the condition in other states, and the institutions in Indiana itself possess only a small percentage of the materials which have been found within the borders of the state.

On account of the enormous and important aquatic vertebrate fauna in the Devonian a very full discussion has been given with illustrations of the varied groups of fishes, whose origins are uncertain, whose fates were either extinction, progression or continued unchanged existence.

There is little differentiation between the vertebrates of the Mississippian and the Pennsylvanian in the Indiana region, and the discussion here is given under the older group heading of Carboniferous. The discussion of the Carboniferous tetrapods is derived from discoveries in Illinois and in Ohio where in ancient swamps, preserved as beds of coal, the upland life of the Paleozoic is preserved. These four-legged creatures had made large progress by the close of the great Coal Period.

The Permian witnessed the close of the Paleozoic Period. On each side of the state of Indiana there are small pockets of Permian fossils: one in Pennsylvania and one in Illinois. Elsewhere the great, arid, Permian period left skeletons of a huge array of amphibians, reptiles, and a few fishes. For the first time true upland vertebrates existed.

The enormous stretches of time during the Mesozoic and the Cenozoic are entirely unrepresented in Indiana, and we know the vertebrates of these large, important epochs by discoveries made far outside, usually to the west and south, of the state limits. The Mesozoic witnessed the origin of birds and mammals, and the rapid growth of many large groups of reptiles, many of which became extinct either during the Mesozoic or at its close.

The Cenozoic, or Tertiary, is rightly called the Age of Mammals. During this time modern mammals developed from a host of groups which lost many elements through extinction. The story of mammal life has been read chiefly from deposits in the western part of the country.

The great Pleistocene Period was full of interest, and Indiana possesses a pretentious record. The most important events, of course, were the successive invasions of great ice sheets, bringing enormous changes in the surface features and in the animal life. The period is usually regarded as having ended about 25,000 years ago: a very short time as geological events are usually regarded. The age witnessed the appearance of man, but this was not in America. It seems strange to find in Indiana undoubted evidences of elephants, tapirs, great ground sloths, and a beaver nine feet long, yet there they lived and left their remains in and around the great ice deposits. Why such creatures became extinct such a short time ago is an unsolved puzzle to paleontologists.

The Recent geological period, in which we are now living, witnessed the development and expansion of the human race. The period is believed to have already existed for 25,000 years, an infinitesimal fraction of time, as it is reckoned geologically. Fifty-five per cent of geological time had passed before life existed in any abundance, and of the 500,000,000 years the whole of the Age of Mammals and the Age of Man represent only a little more than four per cent.

THE RANGE OF VERTEBRATES IN GEOLOGICAL HISTORY

Animals having a spinal column of segmented parts composed of either cartilage or bone are known as *vertebrates.* The modern vertebrates are the fishes, amphibians, reptiles, birds and mammals. It is the history of these groups in geological time which we shall give in the following pages. The term *chordate* is used to designate those ancestral or primitive animals, related to the vertebrates, which have a vertebral axis or notochord in the adult condition, possessed by all vertebrates in their developmental stages. *Chordates* precede the *vertebrates* in geological history since their evidences are known in the Cambrian and in the Silurian and Devonian, during which latter period the true vertebrates, fishes to be sure, appeared in great numbers, known from a multitude of impressions, teeth, scales and bony parts. Fish-like animals have been described as occurring in the second period of geological history, the Ordovician, in Colorado, but the consensus of opinion now is that these rocks are of Devonian age.

A tabulation of the geological column will give the divisions of geological time, with the chief groups of vertebrates which are known to occur in each. The divisions of geological time are essential as names, but it must be kept in mind that geological history was, and is, a continual process. There were no divisions in time itself, but events differed from time to time in the various parts of the earth. While some periods end so abruptly that they seem to have been cut off with a knife, yet history was still being recorded elsewhere.

Eras	Periods	Life of the Period	Dominant Life
Psychozoic	Recent.	Human dominance. Animals of today.	Age of Man.
Cenozoic	Pleistocene or Glacial (Ice Age).	Periodic glaciation. Extinction of great mammals. Dawn of reason, art, industry.	
	Pliocene.	Man-ape changing into man.	
	Miocene.	Culmination of many groups of mammals.	Age of Mammals and Flowering Plants.
	Oligocene.	Rise of higher mammals, primates and modern birds.	
	Eocene.	Vanishing of archaic mammals.	

Eras	Periods	Life of the Period	Dominant Life
Mesozoic	Cretaceous.	Extinction of many groups of reptiles—dinosaurs, mosasaurs, plesiosaurs, pterosaurs.	
	Comanchian.	Reptiles, birds, amphibians and fishes. Rise of flowering plants.	
	Jurassic.	Marine reptiles. Rise of toothed birds and flying reptiles.	Age of Reptiles.
	Triassic.	Extinction of labyrinthodonts. First dinosaurs. Mammal-like reptiles. Mailed fishes.	
Paleozoic	Permian.	Reptiles. Amphibians.	Age of Amphibians and Ancient Fishes.
	Pennsylvanian, also called Upper Carboniferous.	First reptiles—Amphibians, Fishes.	
	Mississippian, also called Lower Carboniferous.	First amphibians. Sharks. Bony fishes.	
	Devonian.	First land vertebrates. Many groups of archaic fishes. Land animals—scorpions.	Age of Fishes.
	Silurian.	Chordates. Armored fish-like animals.	
	Ordovician.	No chordates known. Rise of land plants. Many invertebrates.	Age of the Invertebrates.
	Cambrian.	Traces of chordates. Many groups of invertebrates—trilobites, brachiopods, etc.	
Proterozoic.	Numerous periods.	No chordates known. Invertebrates. Plants.	
Archeozoic.		Unicellular plants. Algae.	

Geologists now believe that the earth has existed during at least 500,000,000 years. Of this time the Paleozoic represents 30%; the Mesozoic 11%; and the Cenozoic 4%. Fifty-five per cent of geological time is pre-Cambrian.

THE GEOLOGICAL HISTORY OF INDIANA

All geological time has been divided into six great eras, which, beginning at the bottom of the series, are called: Archeozoic, Proterozoic, Paleozoic, Mesozoic, Cenozoic, and Psychozoic. These have been given the following percentages as regards their relative duration, given in the same order—30%, 25%, 30%, 11%, 4%, and a fraction for the Psychozoic which is the Recent Period or Age of Man. Life has existed on earth probably all of this time, and the studies of Gruner* are important here.

Geological history is not recorded in surface formations of Indiana until well along in the Ordovician†, the second period of the Paleozoic. Thus all of the Archeozoic, Proterozoic and the Cambrian Period of the Paleozoic Era are unknown within the state except through the records of deep wells.‡ This is not of great importance in the history of the vertebrates because except for scant Cambrian evidence the vertebrates did not leave any records until the upper Silurian, and even then none are known from the rocks of Indiana. The recorded history of Silurian vertebrates has been found in eastern North America, Spitzbergen, Norway and western Europe.

The geological history of the vertebrates in Indiana begins with the Devonian arthrodire, *Macropetalichthys*, and discoveries in nearby regions give interesting accounts of the several groups of fish-like vertebrates which had developed so rapidly within the period. Early Devonian sedimentation is wanting in Indiana, and if found elsewhere will probably contain evidences of the forerunners of the later Devonian animals.

The Mississippian and the Pennsylvanian are well represented in Indiana, and these rocks contain evidences of marine, fresh water, and upland life in the vicinity of the state. The older term Carboniferous includes these two divisions, and the discussion of the vertebrates is given as of the Carboniferous, since we are so far unable to differentiate the vertebrates of these periods. The Coal Measures Amphibians in Illinois and in Ohio are especially well preserved and show a high degree of development.

The rich vertebrate fauna of the Permian period, which witnessed the close of the Paleozoic, is unknown in Indiana.

The entire extent of the long and important eras, the Mesozoic and the Cenozoic, are wanting in Indiana. We have tried to follow the history of vertebrate development from records discovered elsewhere.

The geological records of the Pleistocene, the Great Ice Age, are important and complete. There is a notable record of vertebrate life and we shall compare it with paleontological records elsewhere. Nearly the entire surface of the state was subjected to glacial action and this had an important bearing on vertebrate history.

---

* Gruner, John W. 1923. Algae, believed to be Archean. Journ. Geol., xxxi, 146-148, illus. 1925. Discovery of Life in the Archean. Jour. Geol., xxxiii, 151-152, illus.

† Cumings, E. R. 1922. Nomenclature and Description of the geological Formations of Indiana. Part IV of Handbook of Indiana Geology, pp. 403-570, illus. Publication No. 21, Dept. of Conservation, State of Indiana.

‡ Logan, W. N. 1926. Geology of the Deep Wells of Indiana, 540 pp. 2 illust. Publication No. 55, Dept. of Conservation, State of Indiana.

THE PROBLEM OF VERTEBRATE ORIGINS

The origin of the vertebrates, we may as well say at once, is still an unsolved problem, but the question is of such great importance that eager inquiry continues to bring forth new facts, new theories and new lines of approach. We believe that in time the problem will be solved, but at present all we can say is that the new method of approach has so far not been successful.

Anton Dohrn, believing that the simple vertebrates arose from some annelid group, sought for years the solution of the problem in morphological studies among animals which he thought might yield light on the problem. His results were unsatisfactory and his researches now have only an historical interest.

Gaskell took up the problem from the standpoint of function and structure and concluded that the ancestral vertebrate was a segmented anthropod. His results lacked the proof necessary to acceptance and his studies are now only of historical interest.

Patten took up the problem from the dual standpoint of development and structure and concluded that the ancestral chordate arose from some arachnoid group. However, it is now not generally thought that the vertebrates arose from *any* known invertebrate.

The general aspects of the problem have been changed in recent years by the discovery of possible chordate remains in the Cambrian, and by great discoveries of primitive chordates, in relative abundance, in rocks of Upper Silurian age in various parts of the world, so that at present the problem of the origin of the vertebrates is strictly a paleontological one involving the interpretation of the ancient fossils themselves.

A LIST OF RECENT STUDIES DEALING WITH VERTEBRATE ORIGINS

(1) Kiaer, J. 1928. The structure of the mouth of the oldest known vertebrates, pteraspids and cephalaspids. Palaeobiologica, Bd. 1, pp. 117-134, illus.

(2) ——— 1924. The Downtonian Fauna of Norway. I. Anaspida. Videnskapsselskapets Skrifter. I. Mat. natur. Klasse, No. 6. pp. 1-139, illus.

(3) Simpson, G. G. 1926. New reconstruction of Lasanius. Bull. Geol. Soc. Amer., 37, pp. 397-402, illus.

(4) Stensiö, Eric A: son. 1927. The Downtonian and Devonian Vertebrates of Spitsbergen. Two volumes, illus. Oslo.

(5) Stetson, Henry C. 1927. Lasanius and the problem of vertebrate origin. J. Geol., xxxv, pp. 247-263, illus.

(6) ——— 1928. A restoration of the anaspid Birkenia elegans Traquair. Ibid., xxxvi, pp. 458-470, illus.

(7) ——— 1928. A new American Thelodus. Amer. J. Sci., xvi, pp. 221-231, illus.

METHODS OF COLLECTING FOSSIL VERTEBRATES

The size and complexity of fossil vertebrates introduces new methods for their recovery, preservation, and their exhibition in geological museums. Paleozoic marine vertebrates are largely recorded by teeth and spines and are brought to light in connection with geological field work, as incidents in stone quarrying operations, and by deliberate search. The specimen is secured within a piece of rock, and carried to the laboratory for further exposure, or removal, by the use of sharp-pointed tools, much as invertebrate fossils are handled.

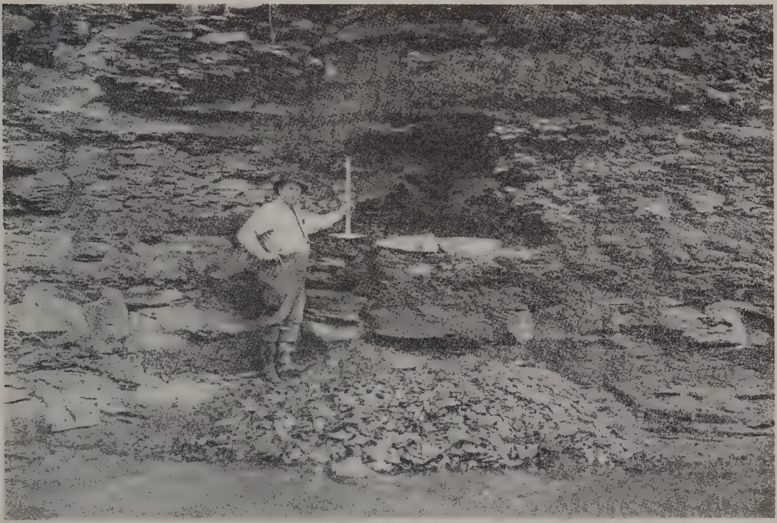

Fig. 2. The flat, light colored concretion at the point of the pick, contained a pressed cladoselachian shark about four feet in length, now preserved in the Cleveland, Ohio, Museum. In order to secure the specimen considerable excavation in the hard Cleveland shale (Devonian) was necessary. This exposure is on Big Creek, near the edge of the city of Cleveland, Ohio. After Hyde.

Many times vertebrate remains are enclosed within concretions or smaller nodules. Sometimes, as at the Mazon Creek beds in Illinois, the enclosed fossil, whether fish, amphibian or insect, forms a plane of weakness along which the nodule splits, following a well-directed blow or the action of frost. The cladoselachians within the large, heavy concretions in the Cleveland shale of Ohio require somewhat different treatment, and careful manipulation in the laboratory is needed to expose the inclosed shark or arthrodire.

If a larger animal is preserved in the rocks the procedure is to first uncover the entire remains, often a laborious task of digging, then to support the friable parts with pasted cloth, plaster or cement, and

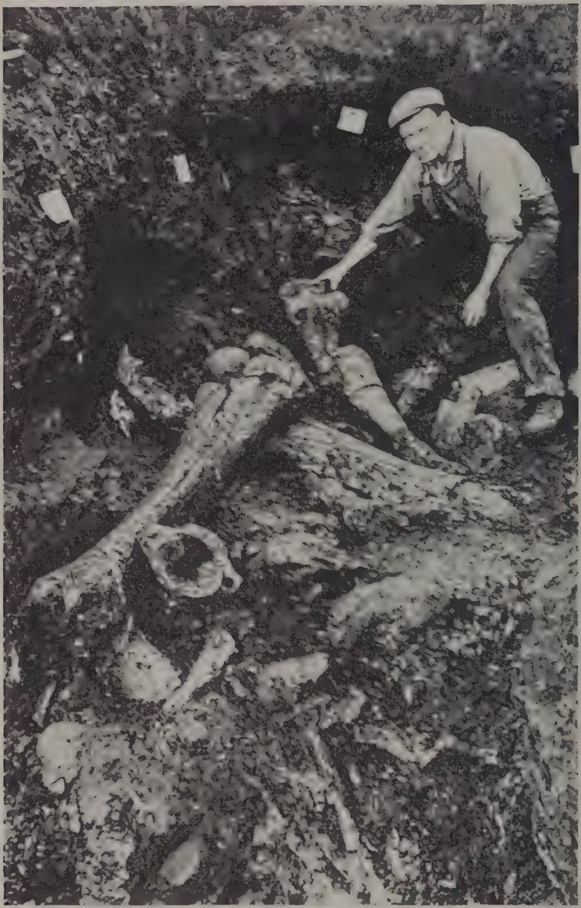

Fig. 3. Pleistocene elephant bones exposed in the bottom of a pit. If the bones are firm and well preserved they can be lifted out bodily, but in case they are friable, care must be taken to avoid injury to the specimens. They must be hardened and treated with shellac or gum and supported by sticks of wood fastened with bandages.

ship to the laboratory with a large amount of matrix, as the mother rock is called.

If a large bone is greatly fragmented and preserved in loose material, the pieces are carefully wrapped to protect the edges, the parts numbered in a diagram which guides the matching of the broken parts in the museum laboratory.

Indian burials may be collected entire by the use of proper hardening of the soil, and crating the entire grave.

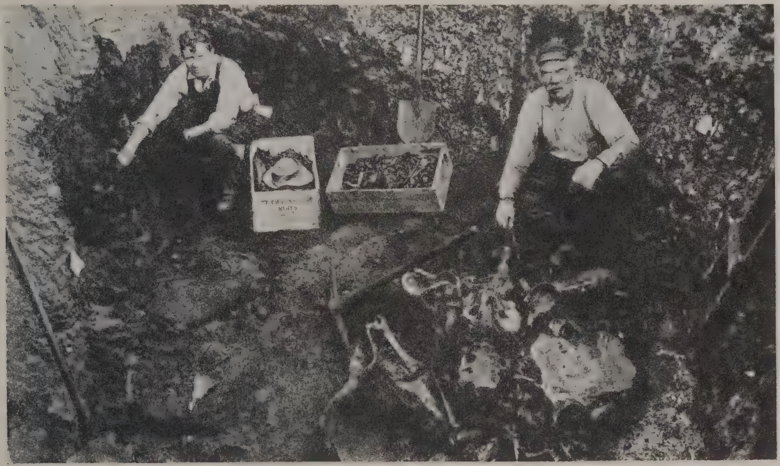

Fig. 4. A heap of bones of the great ground sloth shown in the Frontispiece, exposed in a pit in Pleistocene deposits. These bones were firm and could be readily lifted out.

THE PRE-DEVONIAN VERTEBRATES OF NORTH AMERICA

Scant evidences of the presence of chordates are known from Cambrian rocks of Vermont* and similar problematical fossils† have been discovered by Cobbold in the lower Cambrian rocks of Comley in Shropshire, England. *Eoichthys howelli* is the name proposed for the oldest known American chordate. The size of the single plate in the Cambrian shale is 3 mm. in length by 2 mm. in width. The ellipsoid plate is truncate at one end, and it is ornamented with smooth conical tubercles. If it really is a chordate the plate represents one of the polygonal head scales of an unknown Ostracoderm. Such a discovery is to be expected since recent discoveries in the Silurian show many fish-like chordates to have been fully developed, though small, indicating a long preceding period of growth. One conclusion we may draw from such scant indications is that, in all probability, the chordate ancestral forms were pre-Cambrian in age. We must search in the deposits of the Proterozoic for the ancestors of the vertebrates. The group did not arise from any known group of invertebrates.

One is impressed with the uniformly small size of the pre-Devonian chordates. It has been suggested that this size is due to the scarcity of plant food, which is the basic nutrition. All of the pre-Devonian chordates were small, none of them exceeding a few inches in length. They are believed to have been inhabitants of fresh-water, since the seas were made dangerous by the host of invertebrates, cephalopods, trilobites and others. In the shallow, brackish estuaries the early chordates survived with difficulty, since this was the habitat of the Eurypterids, giant scorpion-like monsters, attaining a length of many feet, with a rapacious appetite needing many primitive chordates to satisfy. The early chordates were better off in fresh water, where they had fewer enemies.

Following the Cambrian period came the Ordovician, in whose rocks students have announced that they found fish-like remains in several places in the western states. It is the consensus of opinion now, however, that these fish-like creatures are in reality of Devonian age, and chordates are unknown in Ordovician rocks.

Not until we get well along into the upper Silurian do we find further traces of chordate life. Bryant‡ announced the discovery in the upper Silurian, in the Bloomsburg shale, of Pennsylvania and in the Guymard Quartzite beds near Otisville, New York, of parts of primitive, fish-like chordates (Figure 5), representing the ostracoderms, of which only the head shields are known. These remains were associated in the rocks with fossils of marine habitat such as the brachiopods, trilobites and eurypterids, which casts doubt upon the restricted fresh-water

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* Bryant, William L. 1926. Evidence of the presence of chordates in the Cambrian. 15th biennial Rept., Vermont State Geologist, pp. 125-126, fig. 1.

† Letter from William L. Bryant, date January 18, 1928.

‡ Bryant, William L. 1926. On the Structure of Palaeaspis and on the occurrence in the United States of fossil fishes belonging to the family Pteraspidae. Proc. Amer. Philos. Soc., lxv, 256-271, illus.

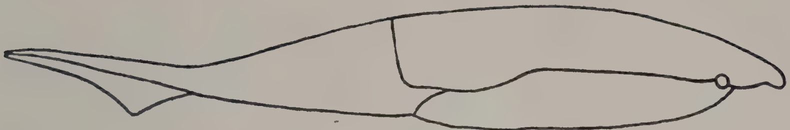

Fig. 5. A restoration of a Silurian chordate, *Palaeaspis bitruncata* Claypole, based on material from the Bloomsburg shale, Perry County, Pa. Related forms are known from New York. The tail is hypothetical. Note the absence of fins. Specimens preserved in Princeton University and in the New York State Museum. After Bryant.

habitat of these early chordates. These ancient Silurian chordates were only a few inches long. Bryant believes that they had migrated some thousands of miles from their ancestral home in northwestern Europe. This migration, of course, took hundreds of thousands of years. A migration rate of a few feet a century would be adequate to account for their presence in such widely removed places as Spitsbergen and Pennsylvania.

More recently Stetson* has described the occurrence of another primitive chordate, *Thelodus,* related to other forms of the European family Coelolepidae, in upper Silurian rocks of New Brunswick, the beds being regarded as Downtonian. The anterior part of the body in *Thelodus* was covered with hard small scales. The animals probably had no true jaws, and hence are included in the group of Agnatha, showing some relationship with the primitive sharks and the Ostracoderms. In length the primitive chordates, the Coelolepidae, were more than twelve inches. Orbits have not been defined in this chordate, and other sensory organs are unknown.

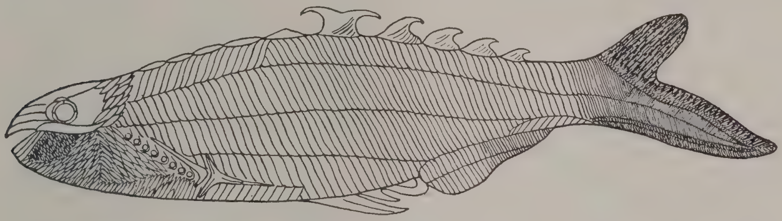

Fig. 6. A restoration of an anaspid, *Birkenia clegans* Traquair, an early primitive, fish-like chordate, found in the Downtonian (Upper Silurian) of Lanarkshire, Scotland. After Stetson.

In order to understand better the real nature of the pre-Devonian chordates as a whole, it will be profitable to give here a brief account of the recent work of Kiaer† and Stensiö‡ on the primitive Silurian chordates of Norway and of Spitsbergen. These investigators had more beautifully preserved specimens than has ever before fallen to the lot of those interested in their structure. Stensiö especially has worked out the entire cranial anatomy—the brain and nerves, the vascular system, and has described and illustrated his findings in an attractive way.

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* Stetson, Henry C., 1928. A new American Thelodus. Amer. J. Sci., xvi, pp. 221-231, illus.

† Kiaer, Johan. 1924. The Downtonian Fauna of Norway. I. Anaspida, with a geological introduction. Videnskapsselskapets Skrifter. I. Christiana.

‡ Stensiö, A. son 1927. The Downtonian and Devonian Vertebrates of Spitsbergen. Part I: Family Cephalaspidae, two volumes, illustrated with 112 plates, 103 text figures. Oslo.

The Cephalaspidae had a broad head shield, and this is all that is usually found, often in detached fragments. No fins are known, and in a single case were anterior trunk scales found, so that the form of the body is unknown. The softer tissues disintegrated and left no trace.

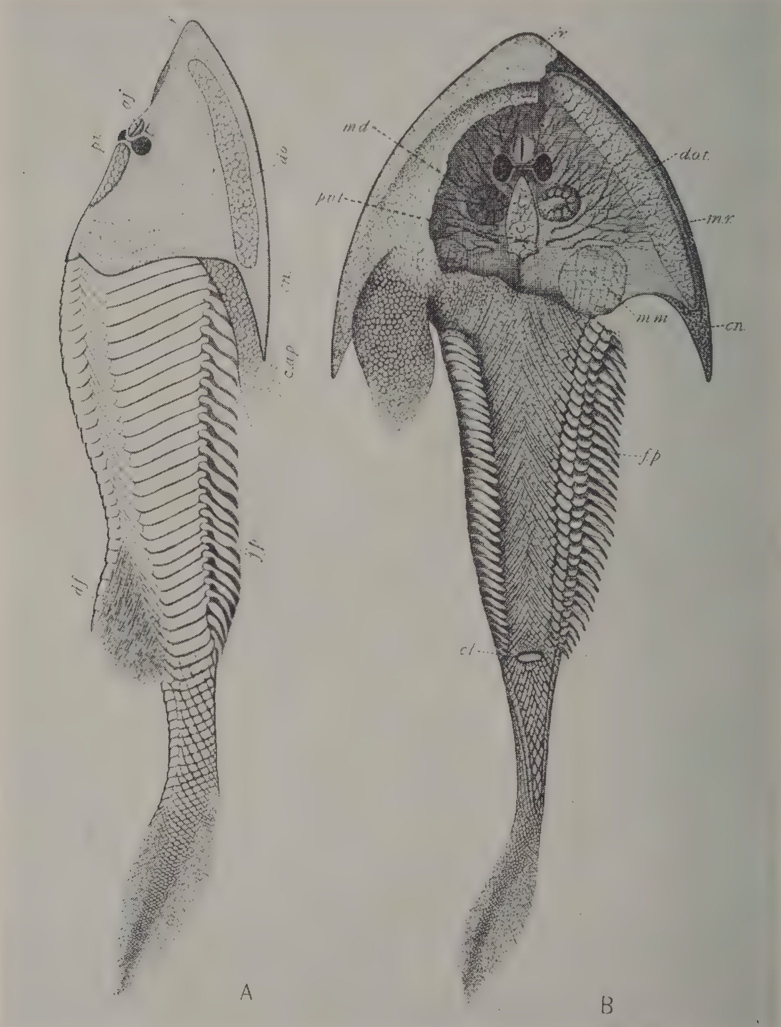

Fig. 7. A restoration of *Cephalaspis*, mainly after *murchinsoni*, a cyclostome-like chordate found abundantly by Stensiö in the Downtonian of Spitsbergen, shown in lateral and ventral views. The head-shield is all that is usually preserved. After Patten.

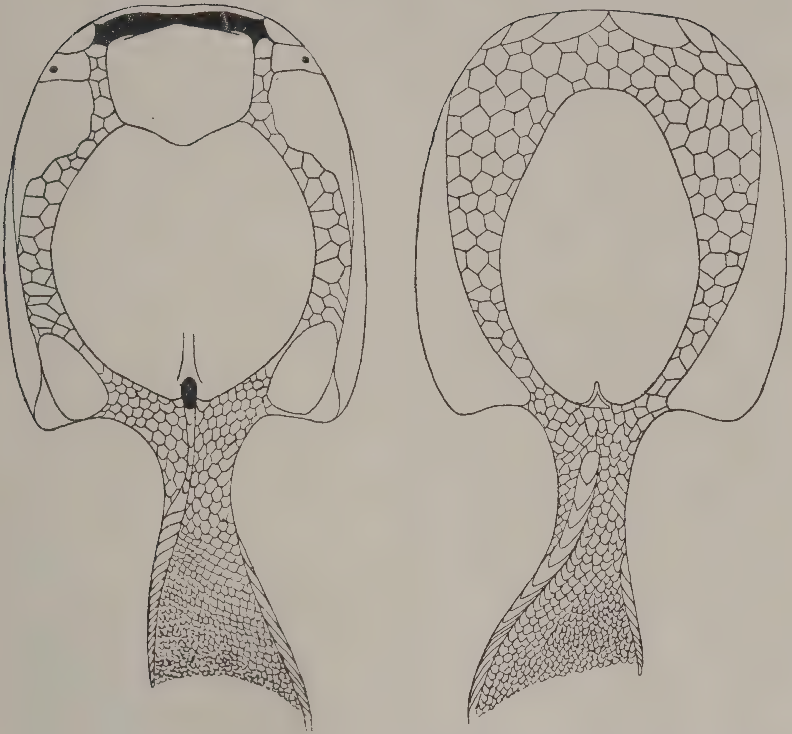

Fig. 8. An early chordate found in Europe, dorsal and ventral views, called by Traquair *Drepanaspis gemündenensis*, based on crushed specimens. The creature was without true jaws, had small ocular organs, no sense of hearing, probably lived on the bottom. After Kiaer.

The eyes were close together on top of the shield which was flattened ventrally and depressed, indicating that these ancient chordates were bottom feeders, and had to watch for enemies from above. They had no true jaws so they doubtless fed by sucking in mud and sand containing small animals and plants. They were only a few inches long and were helpless except in a passive way. Oddly enough there seems to have developed in these creatures electric fields occupying depressed areas which in some forms were covered by numerous small, polygonal plates. The endoskeletal parts were bone-like and strong. Histologically the skeletal parts only remotely resemble bone.

The head shields of the Silurian chordates, the Pteraspidae, found in eastern United States, rarely measure more than two or three inches in length, so the entire animal could not have exceeded 8 or 10 inches. They escaped their enemies by their inconspicuousness and sluggish nature. Partly buried in mud and protected by drab armor, they would not induce an inviting appearance.

These small creatures existed until lower Devonian times, and were contemporaneous with the Cephalaspidae, which Stensiö thinks were related to the cyclostomes or lampreys—eel-like creatures.

This author* has described the sensory canals of two early genera of acraniate chordates, which are rather narrow tubes within the dorsal and ventral shields. The canals are situated in the middle cancellous layer of the material forming the shields. From these definite canals, run off numerous tubules, usually rather short, which go out alternately to the right and left sides of the main canals and open in conspicuous pores. These passages were doubtless for direct communication between vibrations in the water and the receptive end organs within the canals. We thus have a suggestion of the nature of ancient lateral line sense organs.

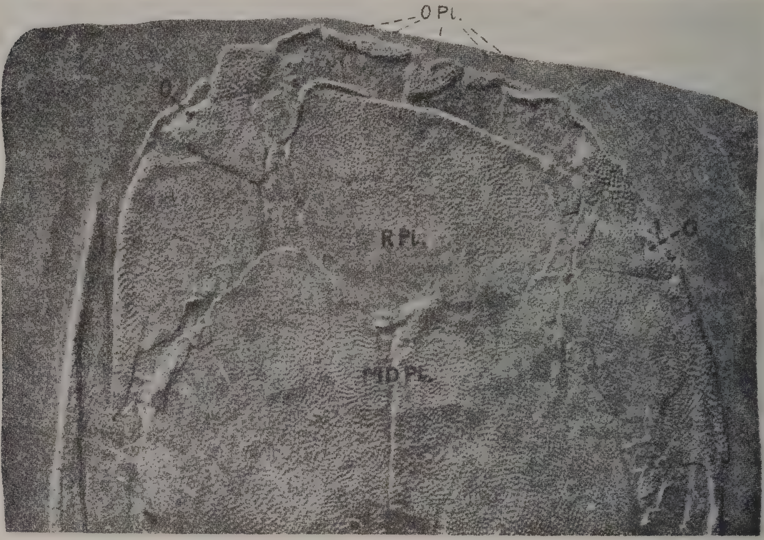

Fig. 9. Photograph of the anterior part of the fish-like animal, *Drepanaspis gemündenensis* Traquair, showing the actual fossil, unusually well preserved.

MDPL: Median dorsal plate. O: orbit. OPL: Oral plates. RPL: rostral plate. From Kiaer after Traquair.

Other sense organs present in these chordates are those of sight, smell, and some specialized function represented by the pineal. These creatures could not hear but were conscious of slow wave vibrations by means of the lateral line system. They had no cochlea.

The gills were six or seven paired, protected by the dorsal head shield. Water breathing was their sole method of obtaining oxygen.

Odd, minute, tooth-like bodies called *conodonts*† (Figure 10) occur-

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* Stensiö, Erik A: son. 1926. On the sensory canals of Pteraspis and Palaeaspis. Archiv f. Zoologi, xviii A. No. 19, p. 1.

† Ulrich, E. O. and Bassler, R. S. 1926. A classification of the toothlike fossils, Conodonts, with descriptions of American Devonian and Mississippian species. Proc. U. S. National Museum, 68, 1-63, 11 pls. Holmes, Grace B., 1928. A bibliography of the conodonts with description of early Mississippian species. Proc. U. S. National Museum, 72, 1-38, 11 pls.

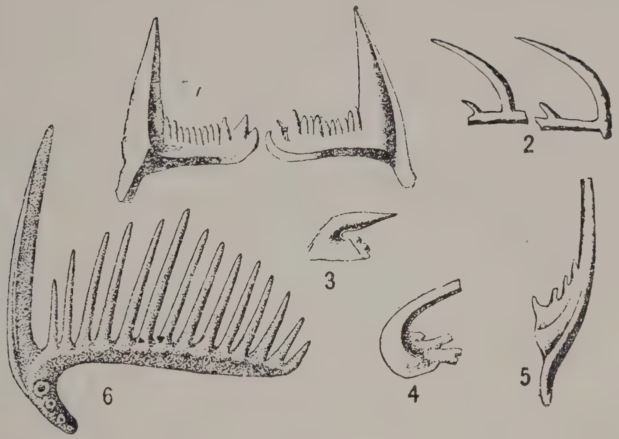

Fig. 10. Some American and European Conodonts, possibly to be regarded as teeth of primitive, shark-like fishes, otherwise unknown. After Bassler and Ulrich.

ring in many formations of the mid-Paleozoic rocks are thought by some writers to be the teeth of small, shark-like fishes. They rarely measure more than 2 or 3 mm. in length, and at times they occur in the rock deposits in incredible numbers. Usually they are of a dark brown to glistening black, often resembling small combs. In the papers cited these objects are said to be of service in determining the position of a rock deposit. No skeletal parts are ever found with them, and except that they exhibit right and left forms little is known of their nature. Some who have studied these objects regard them as jaws of annelids.

Conodonts are known in abundance in rocks of Devonian and Mississippian age but the group, whatever it was—fish or annelid—became extinct near the close of the Paleozoic, and has never reappeared.

If we could, in imagination, transport ourselves back into Silurian times when the early fish-like chordates lived, we would be able to appreciate more readily how different conditions were then from what we find them today. The sun shone then as now; clouds formed and rain fell; the winds blew and ice formed and thunder was probably heard, if there were any to hear. Scorpions and thousand-legged worms were the only air-breathers. There were no land vertebrates. Land plants were few and low. Aquatic plants were found along the coastal embayments where the rocks formed protecting walls. Development of the vertebrate group depended on the expansion of plant life.

Noises in the Silurian were nearly all due to the weather, to the rush of rivers, to the winds, to thunder and the lashing of waves. There were no trees and the only noises due to animal life were the occasional splashes of giant cephalopods as they pursued their prey in ocean waters. We might realize that the only individuals of the vertebrate groups, which later were to rule the world, were small, inoffensive, timid, bottom-living, fish-like chordates, inhabiting the fresh water pools near

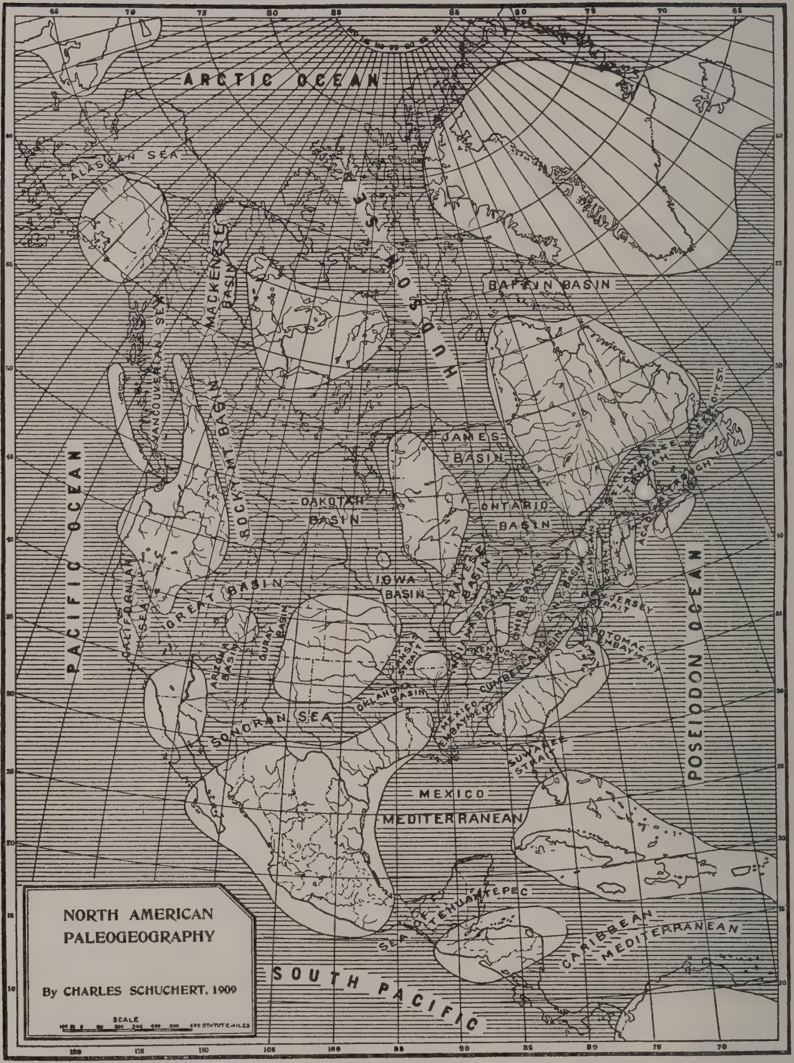

Fig. 11. A paleogeographic map of North America showing location of continental seas in Paleozoic time. After Schuchert.

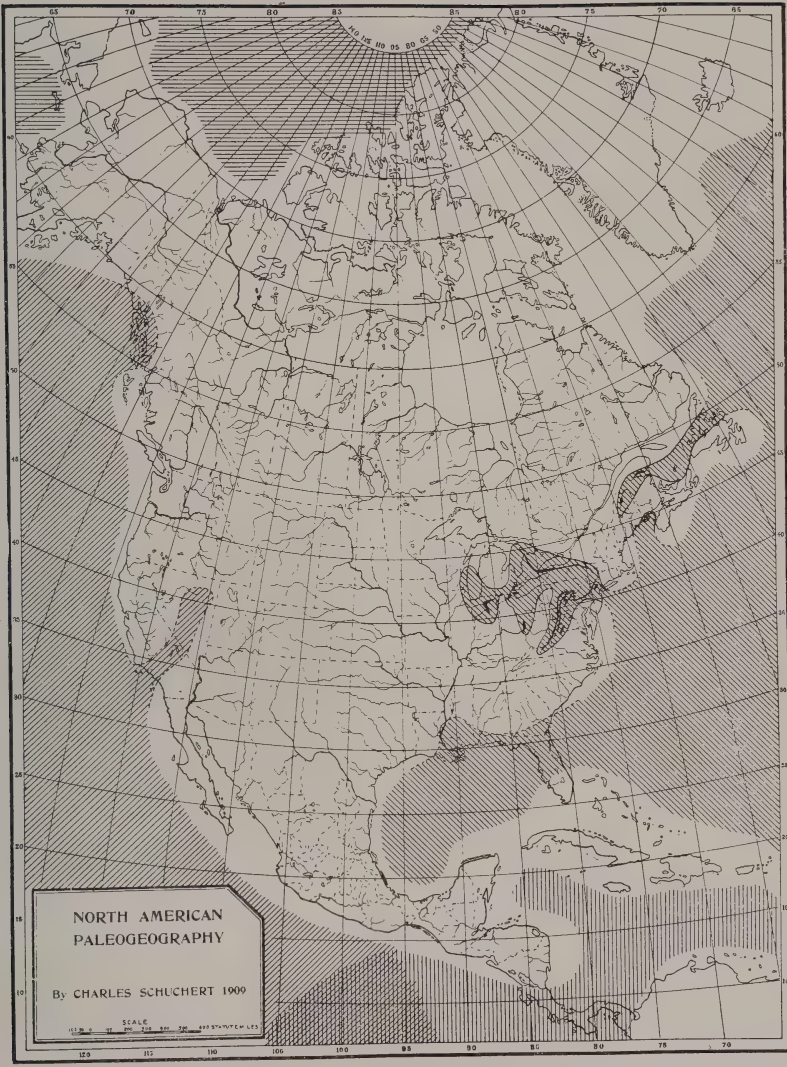

Fig. 12. A paleogeographic map of North America showing land and water conditions during the Upper Silurian. It must be remembered that the early chordates were fresh-water animals and lived at some distance from these marine basins. After Schuchert.

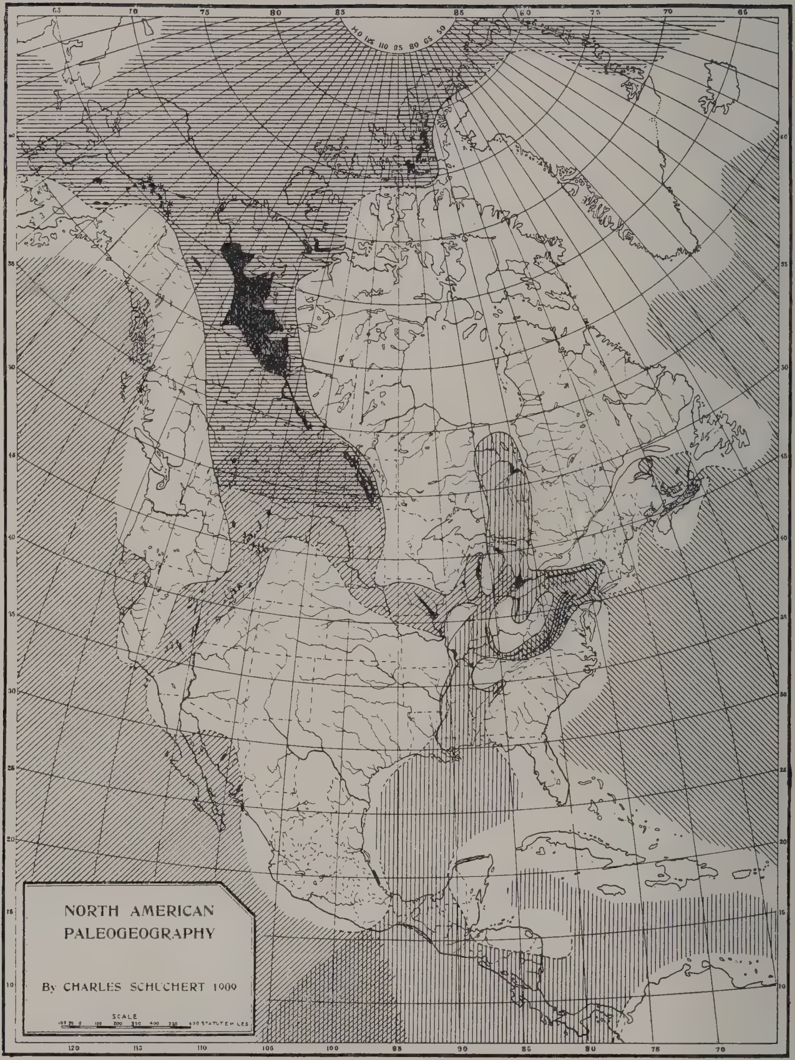

Fig. 13. A paleogeographic map of North America showing expanse of continental seas during the middle Devonian, at which time the Age of Fishes was being established. After Schuchert.

shore or shallow, brackish water bayous. These creatures had no ears capable of hearing, but they depended on their skin sensory organs which were capable of perceiving slow wave vibrations which would warn them of danger. Altogether the Silurian was a very quiet time, but in it were those forces which would later lead to the development and expansion of all vertebrates.

THE FISHES OF THE DEVONIAN IN INDIANA AND ITS ENVIRONS

The Devonian period is well called "The Age of Fishes." During this time many groups of fishes were developed and spread all over the world. We do not know the origins of all the groups, but some are indicated among the Silurian chordates. The possession of heavy defensive armor is common, reaching an extreme development in the head region of the Arthrodira, the superdreadnaughts of the Paleozoic seas. The presence of armor in animals is not an indication of relationship.

Armor among the Devonian fishes consisted of defensive spines, bony plates, cephalic shields, hard and over-lapping scales, and armored appendages. Much of this early defensive armor consisted of osteodentine, but later types were protected by bone. It is thought that the possession of heavy, defensive armor of spines and plates is an indication that the animal group is approaching extinction. It is true that the bizarre, armored creatures of the Paleozoic did not survive the Devonian.

It seems probable that the most primitive defenses of the early vertebrates consisted in scattered plates, tubercles, and scales imbedded in the skin. These defenses became more effective when the adjacent hard parts fused. An account of the structure of the fishes will be given under the different groups.

The various groups of fish-like vertebrates in the Devonian rocks of North America are sharply marked from each other. The Ostracoderms are brought over from the Silurian; ancient and generalized sharks have developed and are known best in the Devonian by the genus *Cladoselache.* The enamel-scaled fishes, the ganoids, begin their long career in this period. True lung-fishes, dipnoans, are found for the first time in these rocks. These dipnoans have persisted throughout all geological time and exist today in the tropics of Africa, Australia and South America, but little changed from their Paleozoic ancestors. A group of large armored fishes, called Arthrodira lived only during the Devonian. Eastman relates them to the lung fishes. Stensiö regards them as affiliated with the sharks—the Elasmobranchs. These fishes were the giants of their day, the rulers of the Paleozoic seas. Modern groups of fishes are foreshadowed by some of the Devonian fishes, but the Arthrodires left no descendants. We do not know their origin, nor why they perished. They played their part in life and disappeared. Perhaps the most interesting of all the Devonian fishes were those crossopterygian forms which appear to possess the germs from which land vertebrates grew. All students are in practical agreement that vertebrate descent is to be traced through this group of crossopterygians.

The intermediate steps are still unknown, but future discoveries will doubtless reveal the manner in which this development took place.

The large size and abundant and diversified forms of Devonian fishes is regarded by some students as being in response to the increased supply of food, both plant and animal. In the Silurian we noted the small size of the primitive vertebrates, correlated with scant plant growth, and active, large invertebrate enemies. Possibly before the close of the Silurian the vertebrates began to expand and attained supremacy very quickly in Devonian seas, that is, as we regard geological time. It doubtless took millions of years to bring about this condition of affairs in vertebrate life.

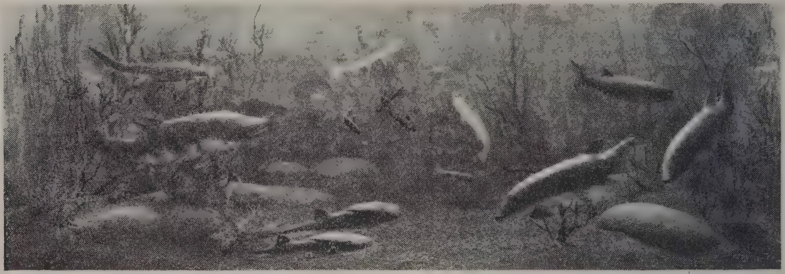

Fig. 14. A fossil fish aquarium in the American Museum of Natural History, showing the various types of Devonian Fishes, based on studies by Bashford Dean.

THE OSTRACODERMS

The ostracoderms, as at present known, constitute a group of primitive, agnathous, armored cyclostomes, of such diverse organization that the group must, with additional material and further study, be subdivided into several groups. The group became extinct during the Devonian and none is known from Indiana, yet to understand the Devonian vertebrates we must include a discussion of them. They were not a dominant group. They were bottom-living animals, rather shunning notice, and hiding from their enemies rather than fight it out with them. In truth they were defenseless, their chitinous armor furnished but little protection. Some of them were practically blind, and their powers of locomotion were limited.

The group reached its maximum development during the Upper Silurian, after which it rapidly declined and became extinct before the close of the Devonian. During its brief career, however, it attained a wide range of habitat, being known from Norway, Spitsbergen and eastern North America (Figures 14, 15, 16).

Most of the ostracoderms were small (Figure 7), usually a few inches long. Two species are known which may have attained a length of two feet. They inhabited shallow, brackish or fresh waters, and swam, flat surface down, through the soft mud, feeding on the minute plants and animals as they went. Most ostracoderms have large rounded or pointed heads, a small trunk, and possibly a long slender tail.

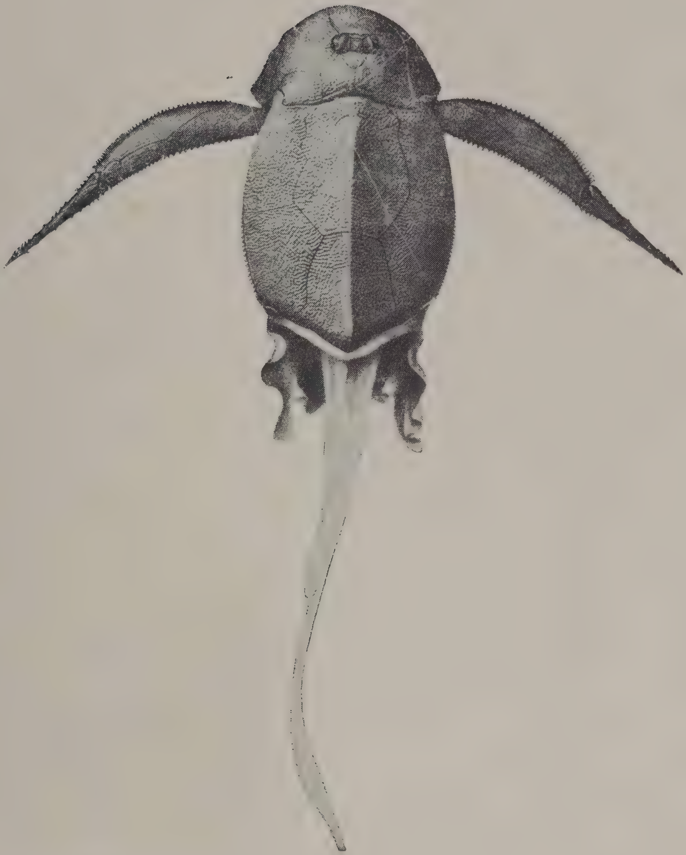

Fig. 15. An American Devonian Ostracoderm, *Bothriolepis canadensis,* showing in dorsal view the structure and appearance of this curious chordate. It is possibly closely related to the modern cyclostomes. After Patten.

The mouth parts of the ostracoderms (Figure 9) differ from other known chordates, and were composed of dermal and basal parts, without true jaws, a condition which some think places the animals in a separate group. Others regard them as cyclostomes.

ANCIENT SHARKS

There are several groups of shark-like fishes in the Paleozoic, our knowledge of which is restricted to teeth, usually isolated, fin spines called ichthyodorulithes, and other dermal defenses. Such fossils range in age from the Silurian to the close of the Paleozoic. Our knowledge of the nature of the Paleozoic sharks is in great confusion. It is obvious that isolated spines, teeth and scales may all belong to the same creature, although the parts may be known by half a dozen different names. The

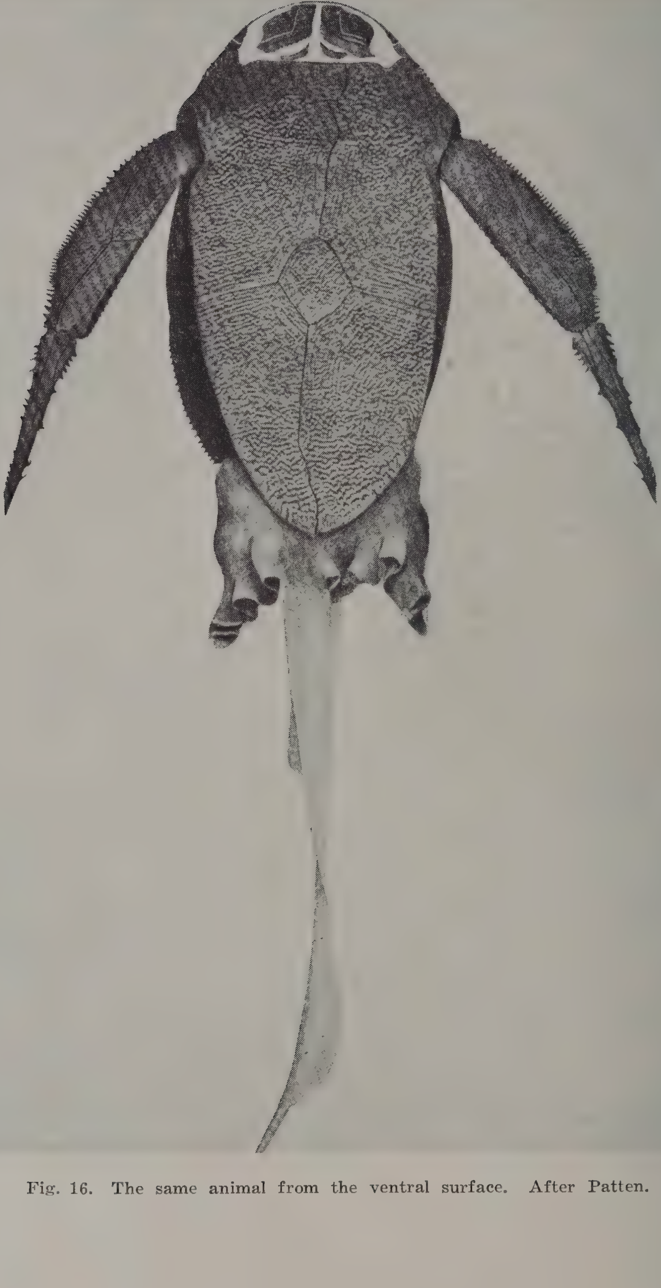

Fig. 16. The same animal from the ventral surface. After Patten.

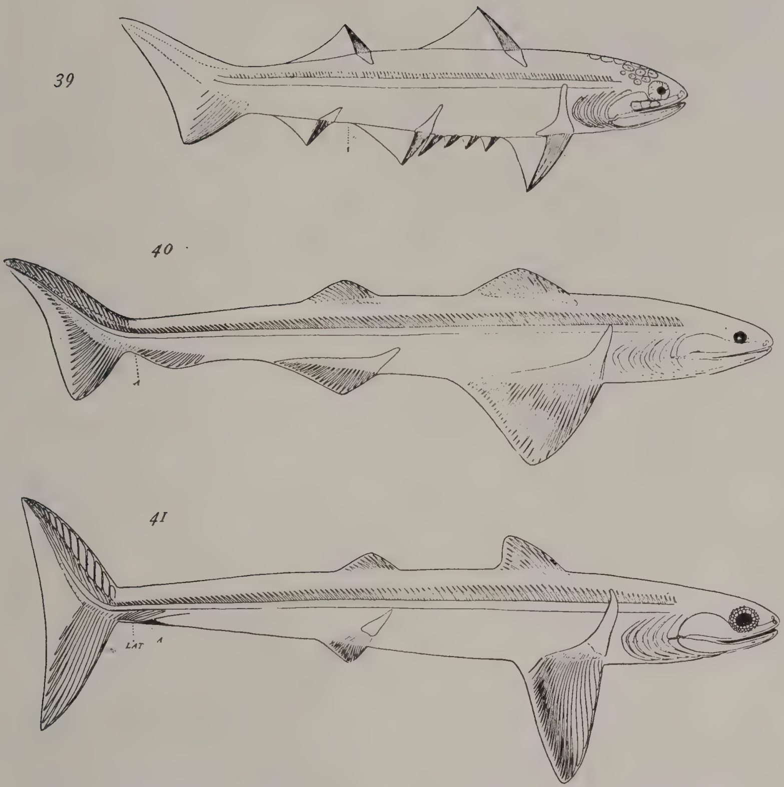

Fig. 17. Cladoselachian fishes as they looked in life. The restorations are based on a large number of specimens collected in the Cleveland shale in Ohio. After Dean.

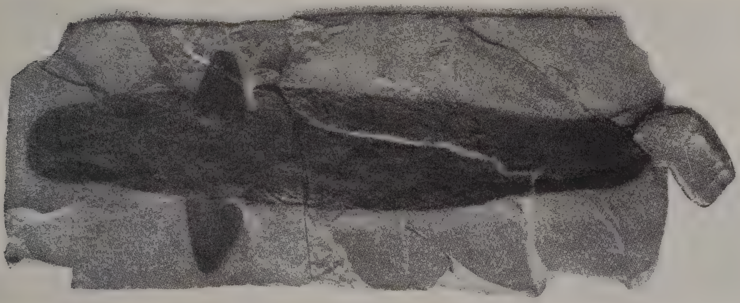

Fig. 18. A Devonian shark as it was preserved in the rock. The body was crushed flat and inclosed in a concretion. After Dean.

endoskeleton of all sharks is soft cartilage, rarely stiffened by deposits of calcium. It is only by the rarest good fortune that a fossil shark is represented by any associated parts. It is also obvious that several species of fossil vertebrates may be founded on different shaped teeth from the mouth of a single shark.

The cladodont sharks, represented by the ten or more species of *Cladoselache,* are known from fairly complete remains found in black Devonian shales, near Cleveland, Ohio.* Not only are the hard parts, teeth and scales, the stiff cartilages of the endoskeleton, and the form of the fins completely known, but we also know the miscroscopical nature of the muscles and kidneys, their food, the lateral line canals, the form of the body, the thin fold connecting the pectoral and pelvic fins, as well as the intimate relations of many of the tissues which are so seldom preserved in fossils.

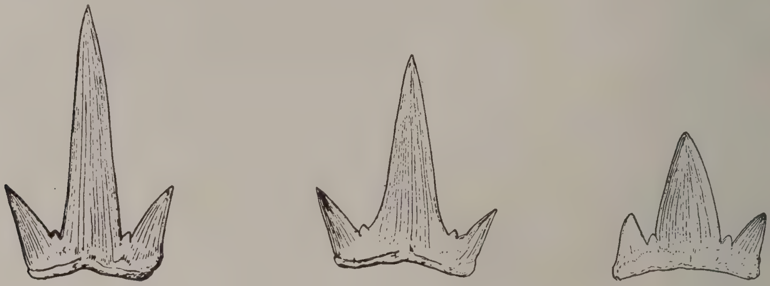

Fig. 19. Teeth from a Devonian shark. After Dean.

While these sharks are thought to have been inhabitants of salt water, yet it has been suggested that the wonderful preservation of the soft parts, within the hard concretions, was due to the inclusion of the dead fishes within soft mud of brackish or fresh-water estuaries. Concretions, with the entire shark or parts of the shark as nucleus, may attain a length of six feet. They are very heavy and weather out slowly from the black shale in which the concretions were found. Other fishes are found fossilized within the concretions, especially parts of the arthrodires, which Stensiö would have us believe are only highly modified sharks. Remains of *Cladoselache* have been collected at Cleveland for more than half a century.

The cladoselachians had a brief history, geologically. Their remains are known from the upper Devonian of New York and Ohio, and from the lower Carboniferous of Kentucky. They were Paleozoic sharks having a notochordal axis, and with paired fins of a peculiarly primitive type. The caudal fin is turned up abruptly. The scales, protecting the body, were small in size and inconspicuous. Only around the eyes did they attain any size, forming sclerotic shields. The absence of an intromittent organ from the pelvic fins leads us to assume that these early sharks did not produce living young, as modern sharks do, but spawned. The cladoselachians were all fairly small, individuals attaining a length of five feet being rare.

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*Hyde, J. E. 1926. Collecting fossil fishes from the Cleveland Shale. Natural History, xxvi, 497-504, illus.

The dentition is fully known. The teeth were trifid, set on a broad base, arranged in about a dozen banks of teeth, each including seven or eight close-set elements. The vasodentine is very thick, and there is no enamel. The gill arches number from five to seven. They were slender and extended far posterior. The fins, supported by radial cartilages, were connected by a lateral dermal fold.

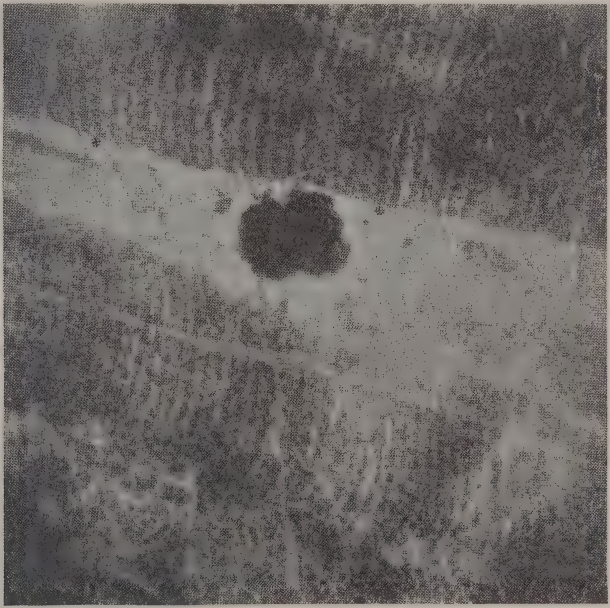

Fig. 20. Photomicrograph of muscle fiber of a Devonian shark, showing cross striations, typical of voluntary muscle. x1000. After Dean.

DEVONIAN CHIMAEROIDS

The chimaeroids, or rat-tailed fishes, are brilliantly colored marine animals, known chiefly to the modern professional zoologists who are interested in them because of their isolated position among fishes, and for their very long and practically uneventful geological history. The fishes have no commercial value and are seldom seen in aquaria. The modern fishes are soft bodied, with few dermal defenses.

These animals are known from abundant and widely scattered dental plates, called "tritors," and fin-spines, in the Devonian rocks of America and Europe. The group is represented at a Devonian locality in Iowa by thousands of water-worn tritors, all contained within a few square yards of rock surface, indicating vast numbers of the fishes at that time. Nothing is known of the bodily form of these Paleozoic fishes, and not until the Jurassic do we find imprints of the soft body. Dean has described a specimen, three feet long, from the lithographic slates of Bavaria, representing an entire fish.

The habit of depositing large egg capsules in which the young developed is as old at least as the Cretaceous of Wyoming, where a complete capsule was found, differing only in details from a modern capsule.

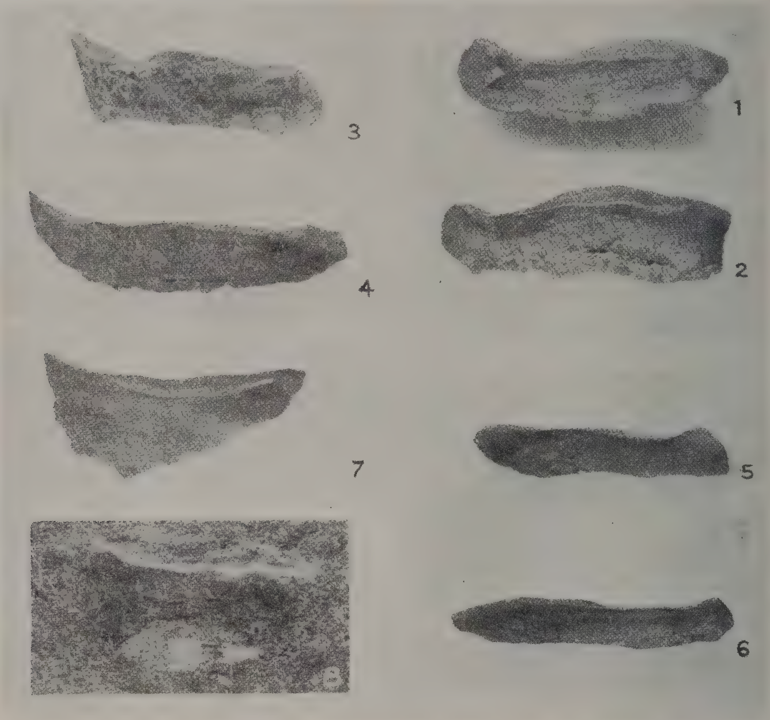

Fig. 21. Tooth-like grinding plates, called "tritors," of a Devonian chimaeroid from Iowa. After Eastman.

THE ARTHRODIRA OR ARMORED FISHES

One of the earliest and most important discoveries of arthrodiran remains was made in Indiana when, in 1846, Norwood and Owen (see bibliography) announced the discovery of a primitive fish to which they assigned the lengthy name of *Macropetalichthys rapheidolabis,* a name which still holds good after more than three quarters of a century. The type specimen was exhibited at the Cincinnati meeting of scientists in 1851, where it was examined by the famous ichthyologist, Louis Agassiz. Newberry mentions it in 1862. Later the specimen was acquired by the University of Missouri. It was redescribed in 1891 by Cope, and a few months later it was destroyed by fire, together with the entire contents of the museum to which it belonged. Recently (see bibliography) Stensiö, after studying undescribed material in the Field Museum of Natural History, has monographed the group and concluded that these primitive arthrodirans are more nearly related to the sharks, the true elasmobranchs, than to any other known group, thus denying their dipnoan affinities as sponsored by Eastman. The six page bibliography given by Stensiö shows the active interest paleontologists have taken in these fishes.

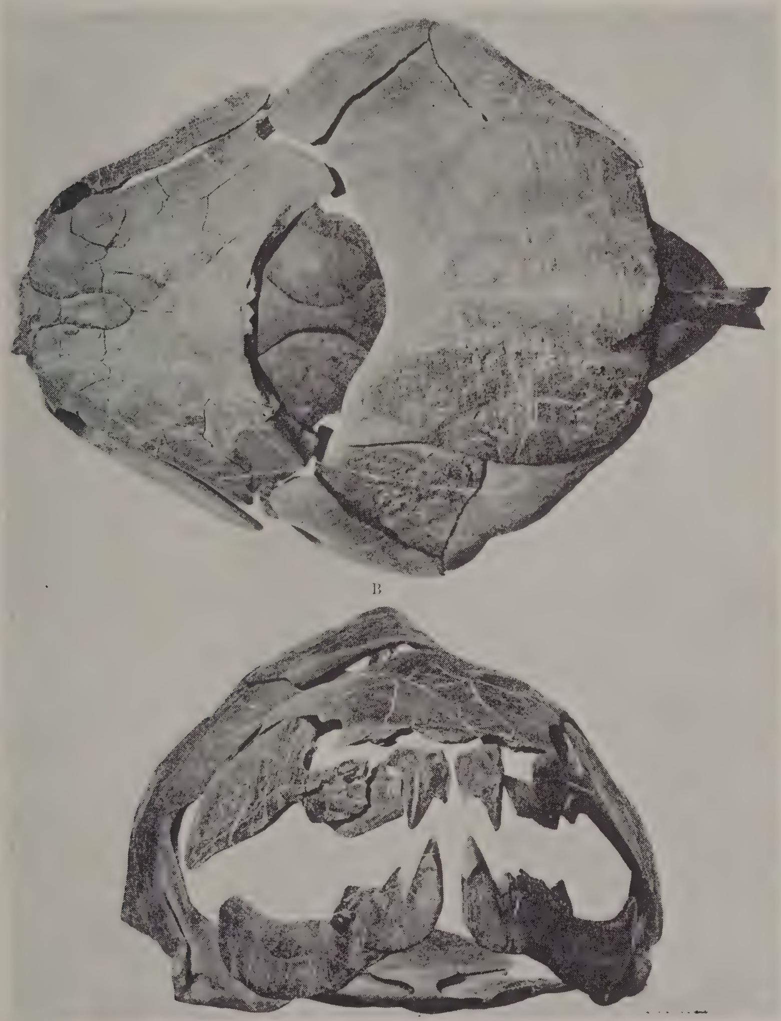

Fig. 22. The bones of the head and shoulders of one of the largest Devonian fishes, *Dinichthys*, as mounted in the American Museum of Natural History. Dorsal and anterior views.

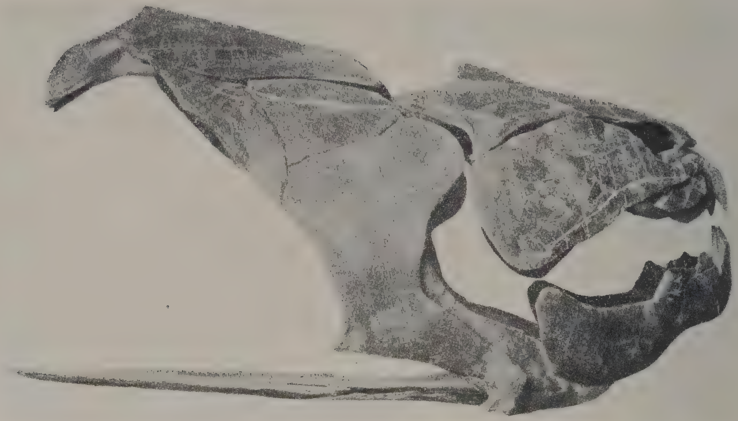

Fig. 23. The same, shown in lateral view.

These huge fish-like animals of the Paleozoic, the "joint-necks" or arthrodires, flourished in Europe and America from the late Silurian to the Lower Carboniferous. During this great stretch of time the arthrodires expanded into about two dozen genera, representing a dozen families and at least three orders (Dean). Their remains are often surprisingly well preserved, but one geologist believes that much more can be learned of these fishes by more careful methods of collecting. Little is known of the bodily form of the larger species, and we are not sure to what group of fishes they are the most closely kin. They have been regarded by various authors as related to the sharks, the chimaeroids, the teleostomes, and the dipnoans.

These fish-like chordates were often of huge size. The largest member of the group, *Titanichthys clarki,* attaining a probable length of twenty feet, is the largest fossil vertebrate found up to the close of the Devonian period. The cranial and shoulder parts of another large genus, *Dinichthys* (terrible fish), have been mounted in the American Museum of Natural History and in the Buffalo Museum of Natural Sciences. Some of the head parts show scars which indicate its ferocious nature—the scars having been made by other arthrodires. When one considers their huge bulk, their capacious mouths and ferocious natures, they may well be considered the rulers of the Devonian seas. Their great bulk would require great quantities of food.

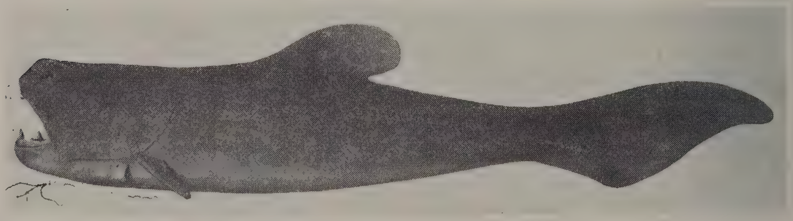

Fig. 24. Restoration of an arthrodire.

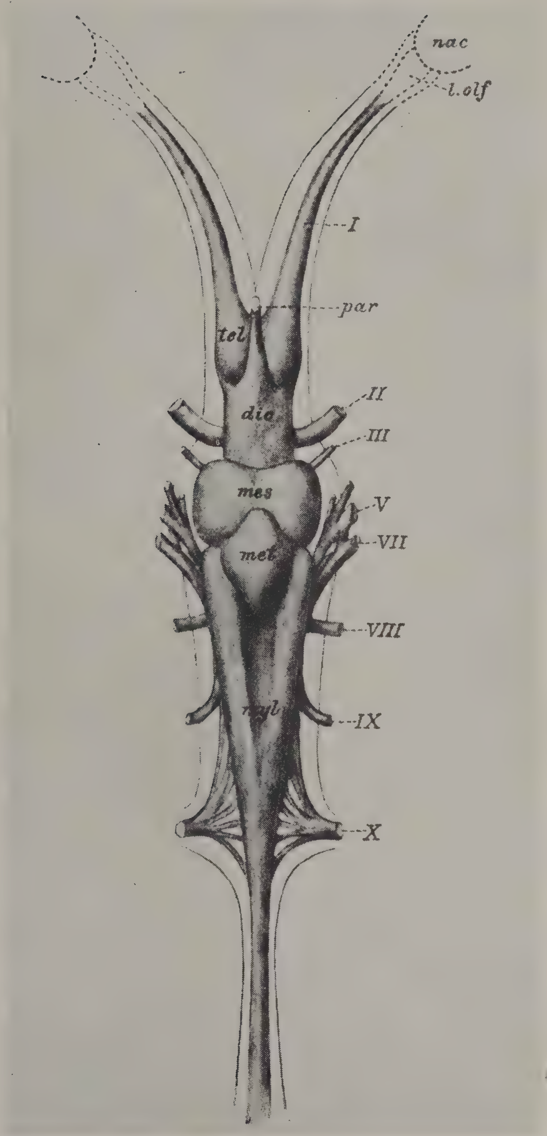

Fig. 25. Hypothetical shape of brain of the Indiana arthrodire, *Macropetalichthys rapheidolabis*, from above in relation to the endocephalic space.
dic, diencephalon ; *l.olf*, lobus olfactorius ; *mes*, mesencephalon ; *met*, cerebellum ; *myl*, medulla oblongata ; *nac*, nasal pit ; *par*, parietal or pineal organs or both ; *tel*, telencephalon ; *I*, tractus olfactorius ; *II*, n. opticus ; *III*, n. oculomotorius ; *V*, roots of trigeminus proper ; *VII*, facialis and trigeminus ; *VIII*, n. acusticus ; *IX*, p. glossopharyngeus, *X*, n. vagus. After Stensiö.

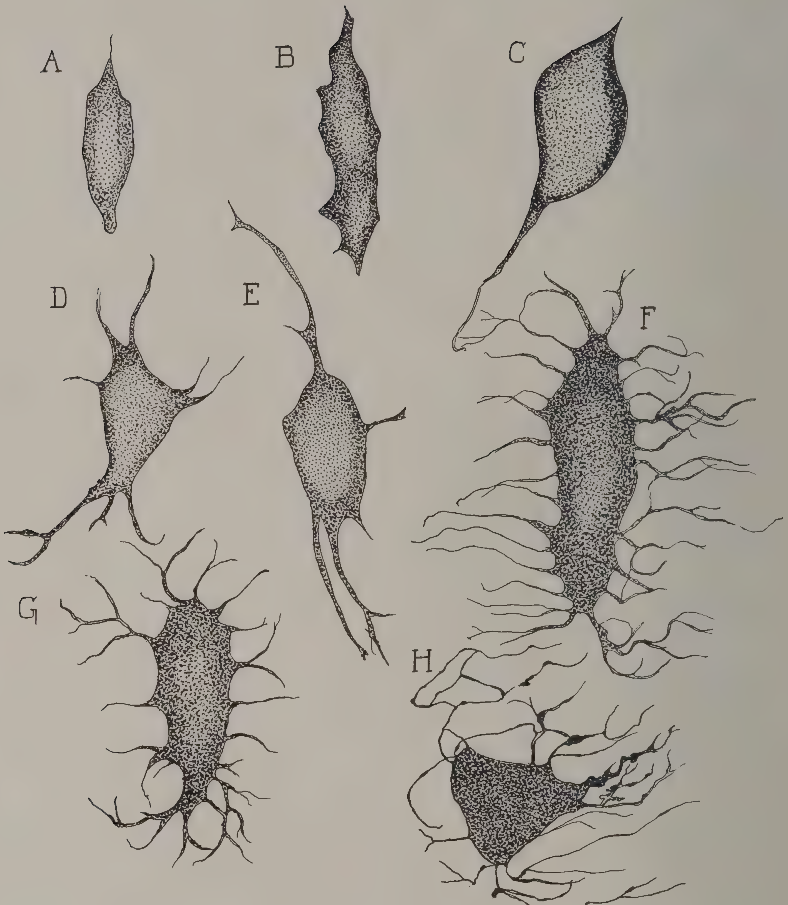

Fig. 26. A group of osseous lacunae from ancient vertebrates showing comparative size and form in different geological ages.

A, Dinosaur, Comanchian of Wyoming; B, spine of a Permian reptile, Red Beds of Texas; C, skull of mosasaur, Cretaceous of Kansas; D and E, marine reptile, Cretaceous of Kansas; F, fossil mammal, Oligocene of Nebraska; G, vertebra of sabre-tooth, Pleistocene of California; H, human, recent.

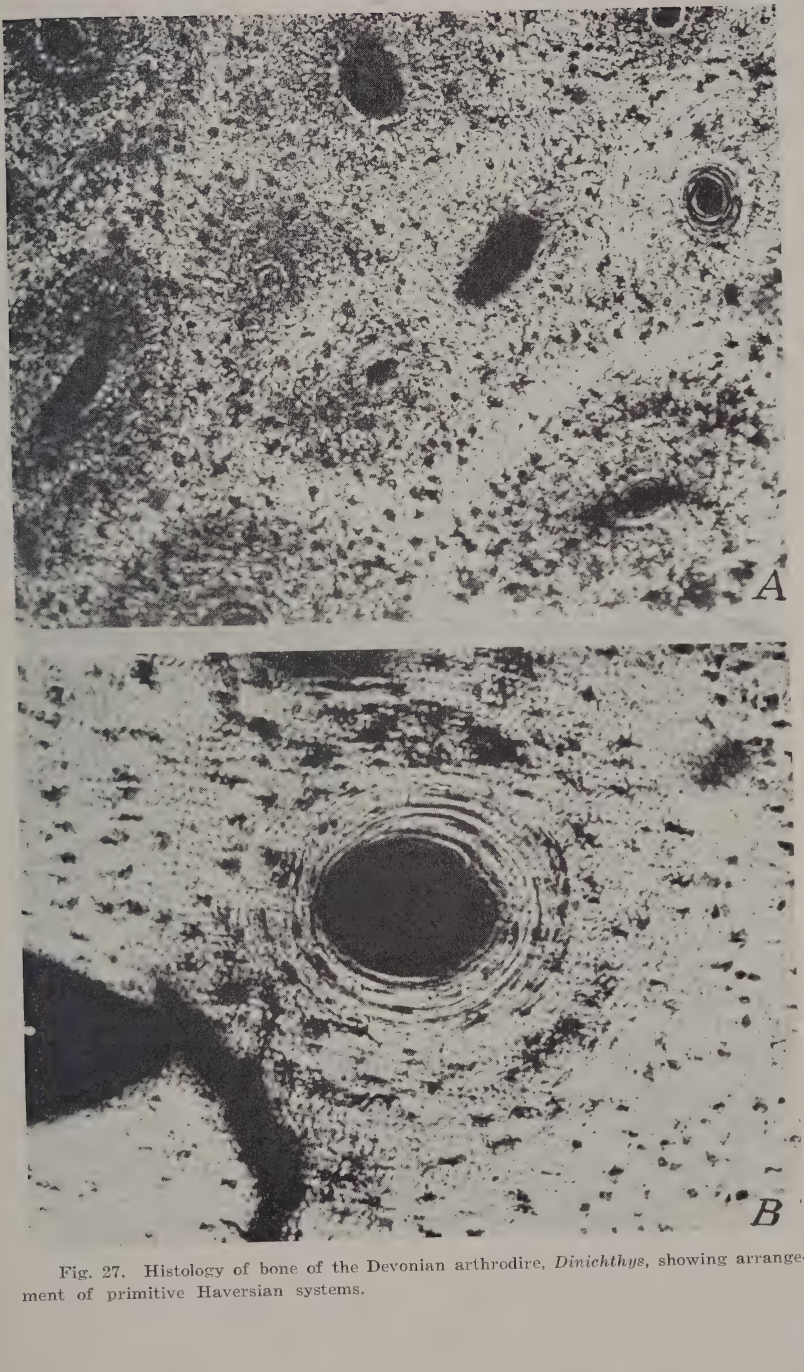

Fig. 27. Histology of bone of the Devonian arthrodire, *Dinichthys*, showing arrangement of primitive Haversian systems.

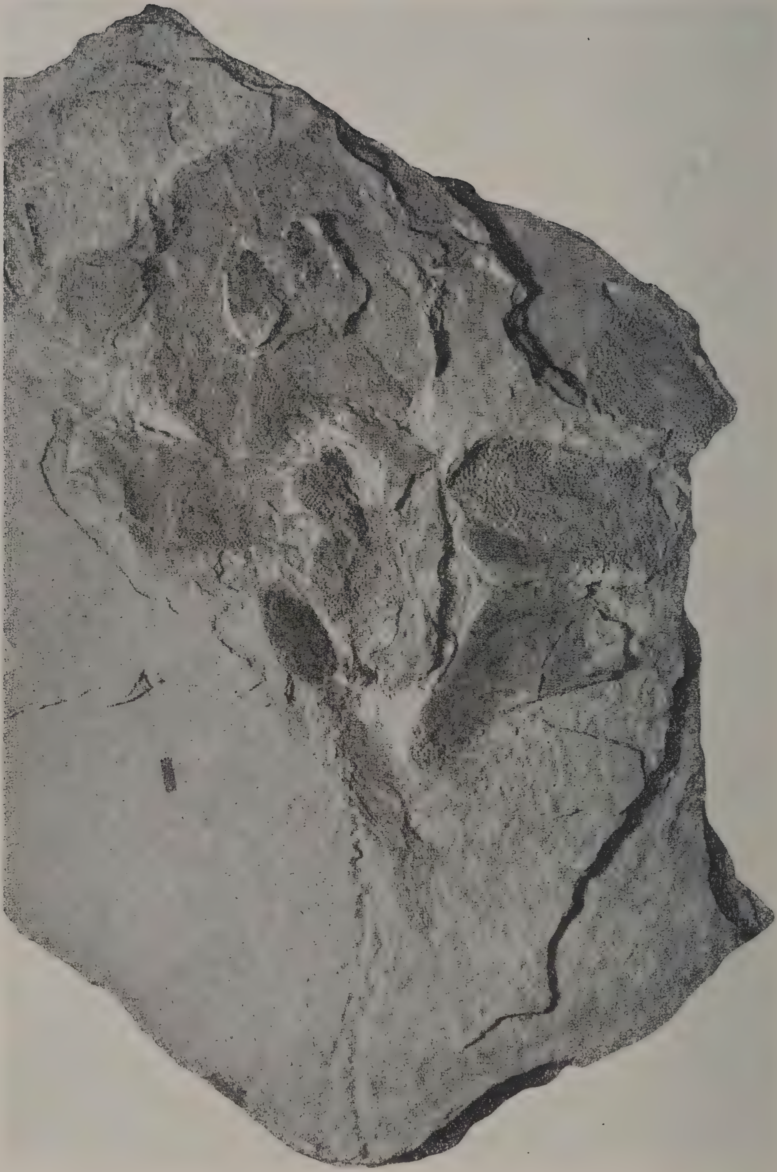

Fig. 28. A small fossilized arthrodire, *Coccosteus canadensis*, about five and a half inches long, from the Devonian rocks of Scaumenac Bay, Canada. Original in the New York State Museum. After Hussakof.

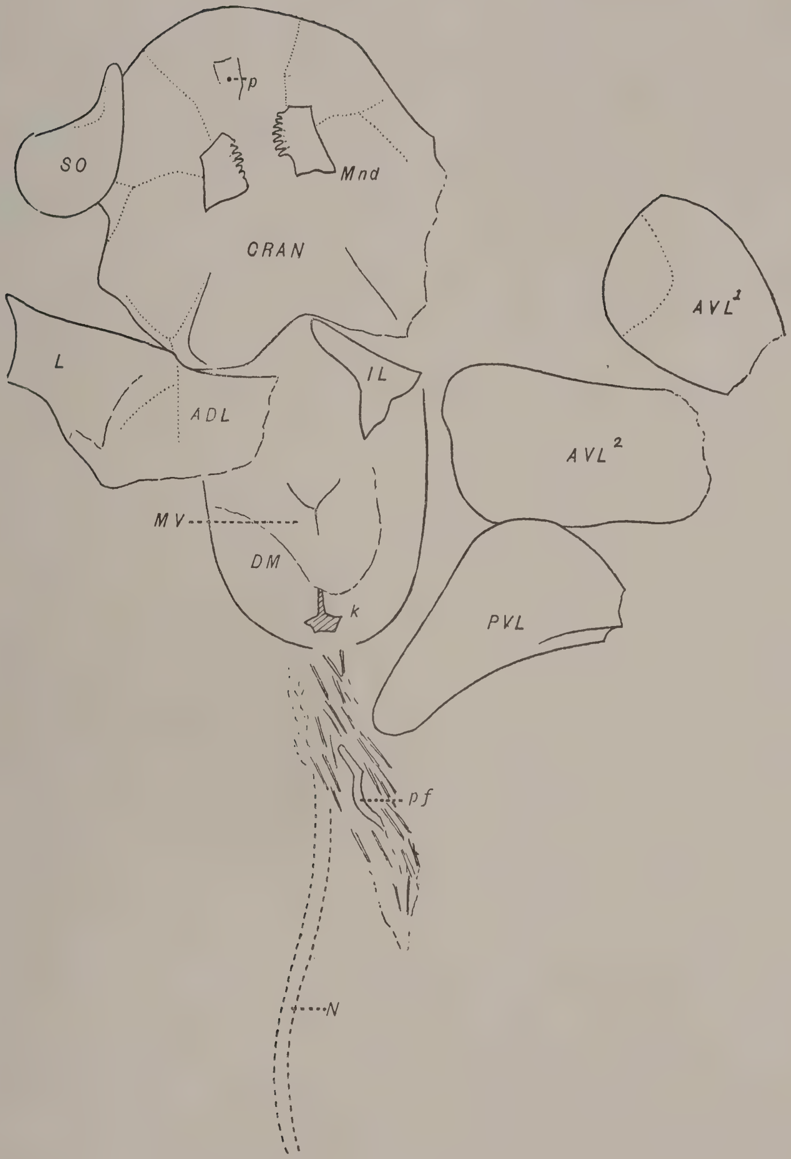

Fig. 29. Outline drawing of the specimen of Coccosteus canadensis Woodard, shown in figure 28.

ADL, anterior dorsolateral; AVL¹, AVL², anterior ventrolaterals; CRAN, cranium; DM, dorsomedian; IL, interlateral; k, "keel" of dorsomedian; L, lateral; Mnd, mandibles; MV, median ventral; N, impression of notochord; p. pineal opening; pf, "pelvic fin support" · PVL, posterior ventrolateral; SO, suborbital. After Hussakof.

The great majority of the group were marine animals, the fishes having gone to the seas from fresh water before Devonian times. A small member of the group, *Coccosteus canadensis* Whiteaves, measuring only a few inches in length, is known from fairly complete material.

The histological structure of the bone in these ancient fishes has attracted much attention,* since it is here that we find the earliest examples of the arrangement of the osseous elements in Haversian systems. All of the essential elements of the system are present. The lacunae are relatively large and the canaliculi well preserved, though never intercommunicating. The Haversian canal is large and extensive. The lamellae stand out clearly. The lacunae of *Coccosteus* differ slightly from those seen in *Dinichthys*, and the Haversian canals are larger.

Bacteria and fungi have been found in the lacunae of *Coccosteus*, these organisms being those of a destructive putrifying nature, rather than indicating disease.

THE LUNG-FISHES

Lung fishes were long regarded as the forerunners of the land vertebrates because of their ability to survive without much water, due to their peculiar respiratory mechanism. Barrell has shown that the dipnoans, as the lung fishes are called, probably acquired this life-saving ability in Silurian-Devonian times, on account of changes of climate. Gregory has given the anatomical reasons why the lung-fishes of the Devonian were not the ancestors of the Amphibia. This group of fishes, known chiefly from dental plates, has survived from Paleozoic times little changed. Dipnoan teeth are characteristic features of many geological horizons. Fairly complete specimens are known from the Devonian and from the Carboniferous.

Fossil lung fishes were first made known by Hugh Miller, the stone-cutter of Cromarty, Scotland, who as a quarryman in the Old Red Sandstone, collected many fossilized remains of Devonian fishes. He made known the anatomy of the early lung fishes so completely that little has been added since. Representatives were later found in America and the Devonian rocks of several states have furnished the remains of a number of species. The fishes are never large. Those collected in the Devonian of Quebec† measure from 3¼ inches to 18 inches, and are often very completely known. The Devonian species are thus about the size of modern lung fishes. The scales and lateral line organs resemble those of modern species, as do the teeth, skull and fins. We may assume that the habit of the modern fishes of aestivating in a ball of mud

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* Moodie, Roy L., 1926. Studies in Paleopathology, XIII. The Elements of the Haversian System in normal and pathological structures among fossil vertebrates. Biologia Generalis, XI, with 12 plates.

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† Hussakof, L., 1912. Notes on Devonic Fishes from Scaumenac Bay, Quebec. N. Y. State Museum Bull., 158, pp. 127-139.

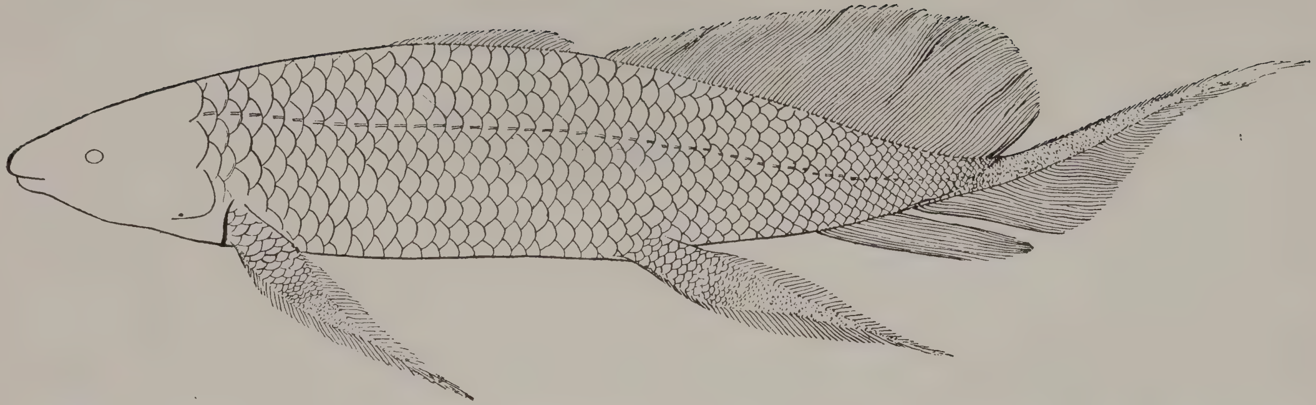

Fig. 30. Restoration of a Devonian Lung-fish, *Scaumenacia curta*, from rocks of the Upper Devonian of Scaumenac Bay, Canada. After Hussakof.

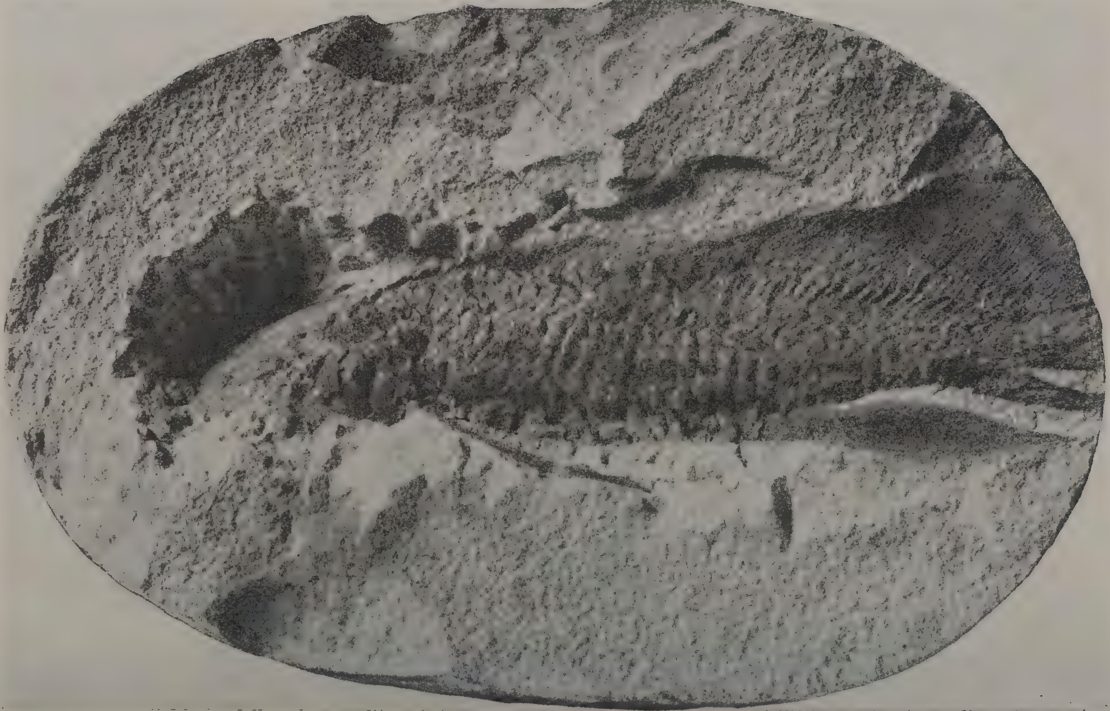

Fig. 31. Fossilized remains of an Upper Devonian Lung-fish, *Scaumenacia curta*, as preserved in a nodule. Original in the New York State Museum. After Hussakof.

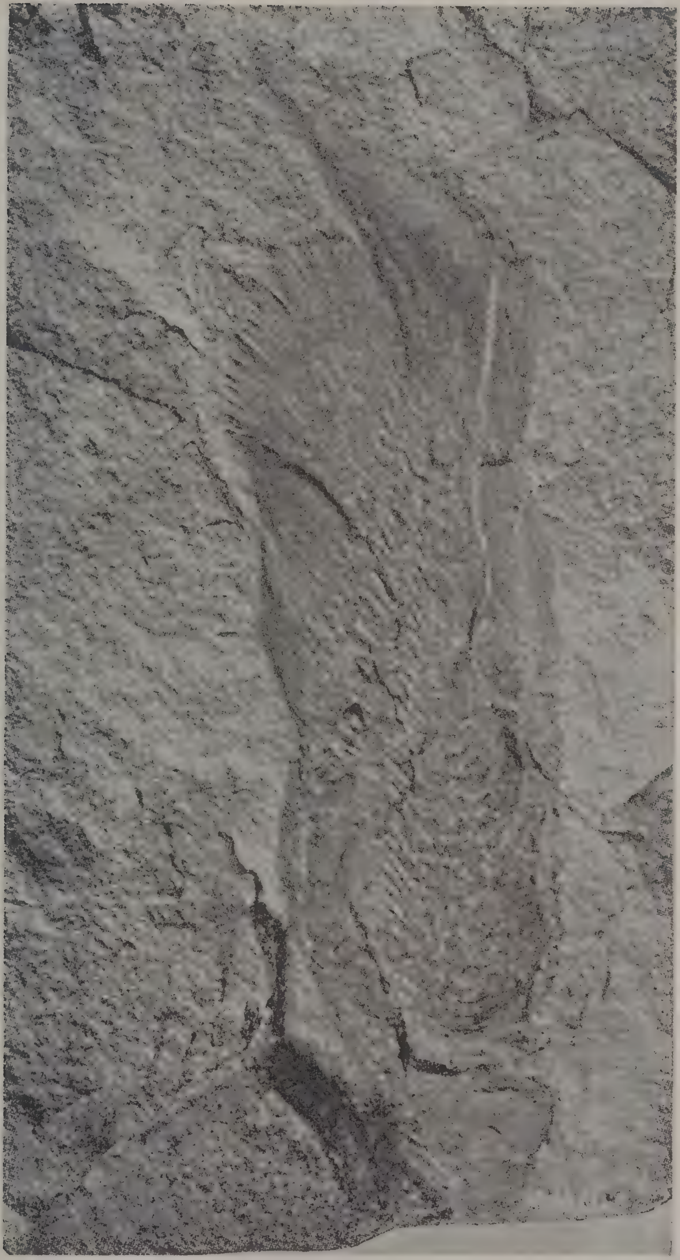

Fig. 32. Another fossilized lung-fish of the same species, showing the tail especially well. Same horizon as above. After Hussakof.

during the dry season had its inception during the Devonian, when the climatic changes were severe enough to have been recorded in the rocks.

The Indiana region has furnished a large number of fossil lung fishes, represented chiefly by dental plates. In certain cases cranial plates which lay on a cartilaginous skull are found, usually single, rarely associated. Eastman divides the lung fishes into three groups, of which he considers the arthrodires to be one. This extreme view is not followed by other writers on Paleozoic vertebrates, and in this paper the Arthrodira are considered separately.

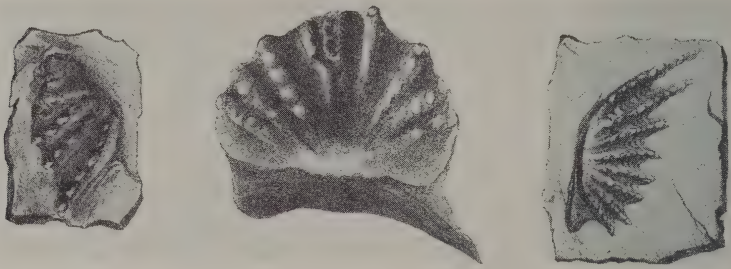

Fig. 33. The teeth of a Lung-fish. They retained the same form through the geological ages. After Eastman.

THE ENAMEL-SCALED FISHES

Small, ganoid fishes of the Family Palaeoniscidae are represented in the Devonian by species of *Rhadinichthys*. The group will be more fully discussed under the Carboniferous and little need be said here save to record the occurrence of several species of these primitive sturgeons, differing even in the lower Devonian when the Paleoniscidae are represented by the genus *Cheirolepis*. The Chrondrostei, or sturgeons, occur throughout the Mesozoic period and show a gradually diminishing representation during the Cenozoic, and down to the present time. The heads of certain small fishes of the genus *Rhadinichthys*, enclosed in nodules, show well preserved brains, semicircular canals, arteries, nerves and other soft structures.

CROSSOPTERYGIAN FISHES OF THE DEVONIAN

The group of fishes called Crossopterygians, are regarded as the direct ancestors of Paleozoic and modern land vertebrates. Among the many fish-like vertebrates found in Devonian rocks of North America none possesses a greater interest than the crossopterygians, of which there are several known genera. The best known species is the fish, *Eusthenopteron foordi,* known from nearly complete skeletal remains from the upper Devonian of Canada, where one example three feet long has been described. We shall discuss briefly the anatomical characters of this fish, as described by Bryant.*

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* Bryant, W. L., 1919. On the Structure of *Eusthenopteron.* Bull. Buffalo Soc. Nat. Sci., xiii, pp. 1-22, plates 1-19, figs.

Eusthenopteron was a rather slender, round bodied fish. It was an active, voracious animal of predatory habits. Its head occupied a little more than one quarter of its length and its greatest depth was contained more than five times in its total length (Figure 34). The body was covered with rather small cycloid scales, and a single enlarged ridge scale occurs immediately behind each of the dorsal and anal fins. The scales are formed of three layers of osteoid tissue resembling true bone. The bones of the skull are thin and in their arrangement resemble those of the later amphibians (Figure 35). The orbits are rather small, with sclerotic plates defending the eye. The lower jaw is long, slender and beset with teeth, and cut by the lateral line canals, as are the bones of the skull.

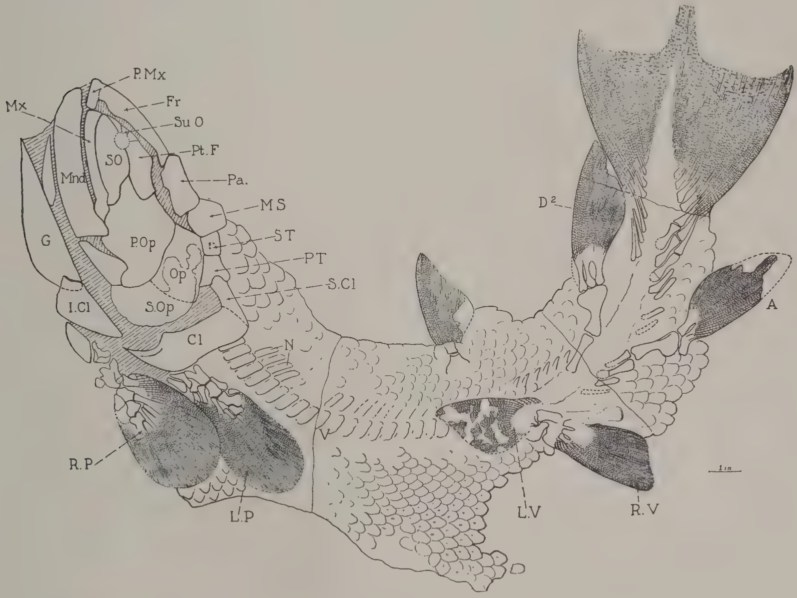

Fig. 34. *Eusthenopteron Foordi,* Whiteaves, Scaumenac Bay, Quebec. Specimen in New York State Museum.

A, anal fin; Cl, cleithrum; D^1, D^2, dorsal fins; (D^1, accidentally omitted in lettering, should indicate the fin in front of D^2) Fr, frontal; G, gular plate; I. Cl, infraclavicle; L. P, left pectoral; L. V, left ventral; Mnd, mandible; MS, median supratemporal; Mx, maxilla; N, neural spines; Op, operculum; Pa, parietal; P. Mx, premaxilla; P. Op, preoperculum; PT, posttemporal; Pt. F, postfrontal; R. P, right pectoral; R. V, right ventral; S. Cl, supraclavicle; SO, suborbital; S. Op, suboperculum; ST, lateral supratemporal; Su. O, supraorbitals; V, vertebral centra. After Hussakof.

The pectoral fin (Figure 36) partakes of the structure of a limb, and on its structure is founded, largely, the suggestion that this group of fishes stood in an ancestral position to the land vertebrates. Its parts are regarded as homologous with those of the tetrapod limb. Naturalists the world over are agreed that the crossopterygians and the amphibians have a genetic relationship.

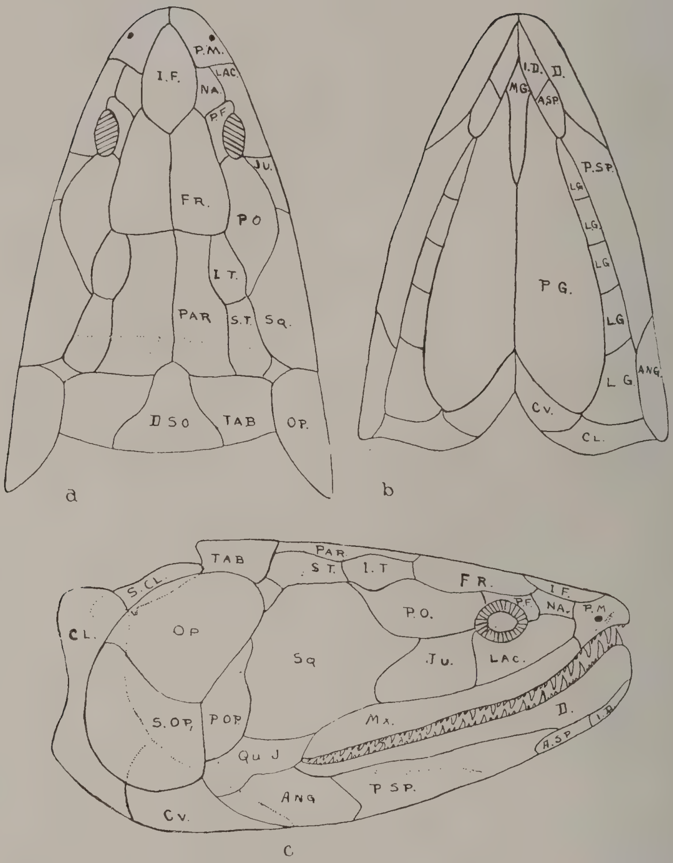

Fig. 35. Skull Pattern of *Eusthenopteron foordi* Whiteaves. a dorsal, b ventral and c lateral view. Ang., Angular; A. Sp, Anterior splenial; Cl, Cleithrum; Cv, Clavicle; D, Dentary; D. So, Dermosupraoccipital; Fr, Frontal; I. D, Infradentary; I. F, Interfrontal; I. T, Intertemporal; Ju, Jugal; Lac, Lacrymal; L. G, Lateral Gular; M. G, Median Gular; Mx, Maxilla; Na, Nasal; Op, Operculum; Par, Parietal; P. F, Prefrontal; P. G, Principal Gular; P. M, Premaxilla; P. O, Postorbital; P. Op, Preoperculum; P. Sp, Posterior Splenial; Qu. J, Quadratojugal; S. Cl, Supracleithrum; S. Op, Suboperculum; Sq, Squamosal; S. T, Supratemporal; Tab, Tabulare. After Bryant.

(Sensory canals indicated by double dotted lines.)

The transformation of animals from fishes to amphibians involved the loss of the tail as the chief propelling organ; the loss of dorsal and anal fins, and their expanded basal supports; the loss of a completely scaled condition, for some of the Coal Measures amphibians possessed scales; great muscular adjustments: the acquirement of lungs and air-breathing; and change in food habits.

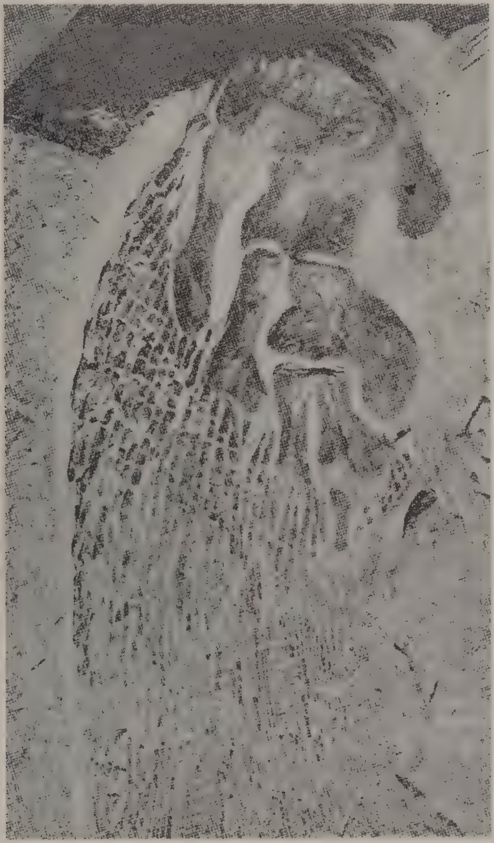

Fig. 36. A fossilized left pectoral fin of a crossopterygian fish, *Eusthenopteron foordi,* Whiteaves, with its supports which are thought to represent the arm bones of the higher animals. After Bryant.

THE DAWN OF MODERN FISHES

There can be no doubt that the various groups of modern fishes were outlined early in the Devonian or even in the Silurian. The cyclostomes, or lampreys, were represented in these periods by the ostracoderms. True sharks are foreshadowed by species known from teeth and spines; by the cladoselachians and possibly the arthrodires which Stensiö regards as elasmobranchs. The Chimaeroids began their enormous history of many, many millions of years during the Devonian and have changed but little in all subsequent geological time. True lung-fishes are fairly abundant in Devonian rocks and are represented by well-preserved fossils. The group, known as Dipnoans, was firmly established during Devonian times and has had a long, subsequent history almost unchanged. The Crossopterygians are known today in scant numbers and have changed but little. The ganoid fishes, with the body protected by enamel scales, were established in early Devonian times.

Today the dominant group of fishes is the bony fishes, which are not represented among the fossil vertebrates known from Devonian rocks. Their history began later. The diverse modifications of the bony fishes have been accomplished in relatively recent times.

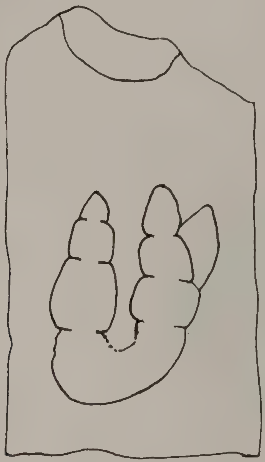

Fig. 37. The oldest known amphibian footprint, *Thinopus antiquus*, from the Upper Devonian of Pennsylvania. Track about four inches long. After Lull.

TRACES OF LAND ANIMALS IN THE DEVONIAN

Many years ago Professor Marsh of Yale University described, under the name *Thinopus antiquus*, a single footprint nearly four inches long which still remains the only evidence of land vertebrates during the Devonian. The track is from a marine sandstone of the littoral or beach area over which the animal walked, probably in search of dead marine animals. The footprint stratum is associated with others that are ripple-marked and sun-cracked, and bear rain imprints.

The imperfection of the track was not understood until Morton* by careful modeling showed how the middle toe may have been raised so as not to make a perfect imprint.

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* Morton, Dudley J., 1926. Notes on the footprints of Thinopus antiquus. Amer. J. Sci., 5th ser. xii, 409-414. 6 figs.

Since scorpions, myriapods and other land-living arthropods are known to have existed during Silurian time, it is a safe assumption that their race was continued through the Devonian. Insects developed along with the expansion of plant life, and Devonian land plants are known. It was during the Devonian that the first forests* were developed.

FISHES WHICH LIVED DURING THE CARBONIFEROUS

Conodonts (see Figure 10) which may represent an otherwise unknown group of fishes, are found abundantly in rocks of Mississippian age in the states bordering on Indiana, and serve as time-markers for the subdivisions of that period (see papers by Ulrich and Bassler, and by Holmes). Conodonts continue in diminishing numbers throughout the rest of the Paleozoic, to disappear entirely shortly before its close.

Ichthyodorulithes are fin-spines, fragments of bone, and other osseous manifestations of fishes whose skeletons are largely cartilaginous. These objects and teeth (Figures 39 and 40), often found in marine deposits of the Mississippian and Pennsylvanian, represent nearly all we know of the elasmobranch fishes of this time. Rarely impressions are found which aid in correlating the known skeletal parts. It will be obvious that fin spines and teeth of different shapes, assigned to several genera and species, may be, in fact, parts of one and the same animal. Paleoichthyologists, aware of this, are always on the alert to correlate their finds as rapidly as possible, but a great deal remains to be done. As an example of this we may cite the example of the Carboniferous fossil called *Edestus*, a group of shark-like fishes known from a score of species, from several parts of the world. The tooth-bearing spine was for a long time thought to belong to the anterior dorsal fin, until a fortunate discovery enabled Dr. Hay† to show that the *ichthyodorulite* called *Edestus* was a part of the jaws of a Paleozoic Cestraciont shark. Another related shark, with similar oral defenses has been described from the Carboniferous of Russia.

A large number of *sharks* (Elasmobranchii), classified into several families, are known from the rocks of the Carboniferous system in Indiana and the bordering states. The various shapes assumed by the teeth give rise to names which are descriptive of the teeth, rather than indicative of relationship. Such terms as Cladodont, Petalodont, Cochliodont and the like give rise to family names as the Cladodontidae, Cochliodontidae and the other similarly named groups.‡ Such objects occur in rocks of Mississippian and Pennsylvanian age and have been elaborately figured and described in a large number of exhaustive reports and memoirs. One seldom sees them discussed within recent years. Paleontologists of half a century ago reaped the entire field.

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* Goldring, Winifred, 1927. The oldest known petrified forest. Scientific Monthly, xxiv, 514-529, illus.

† Hay, O. P., 1912. On an important specimen of Edestus. Proc. U. S. Natl. Mus., 42:31-38, pls. 1-2.

‡ Eastman, Charles R., 1917. Fossil Fishes in the Collection of the United States National Museum. Proc. U. S. Natl. Mus., 52:235-304, pls. 1-23.

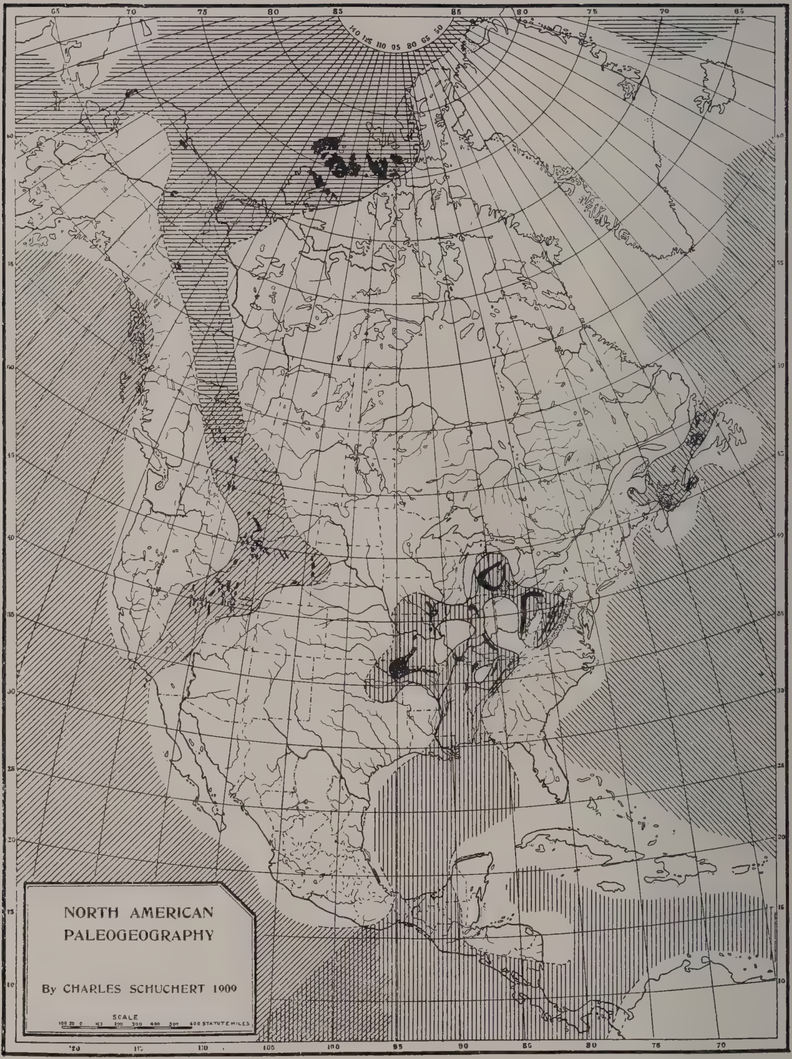

Fig. 38. A paleogeographic map of North America, showing details of land and water during the Middle Mississippian (Burlington) times. After Schuchert.

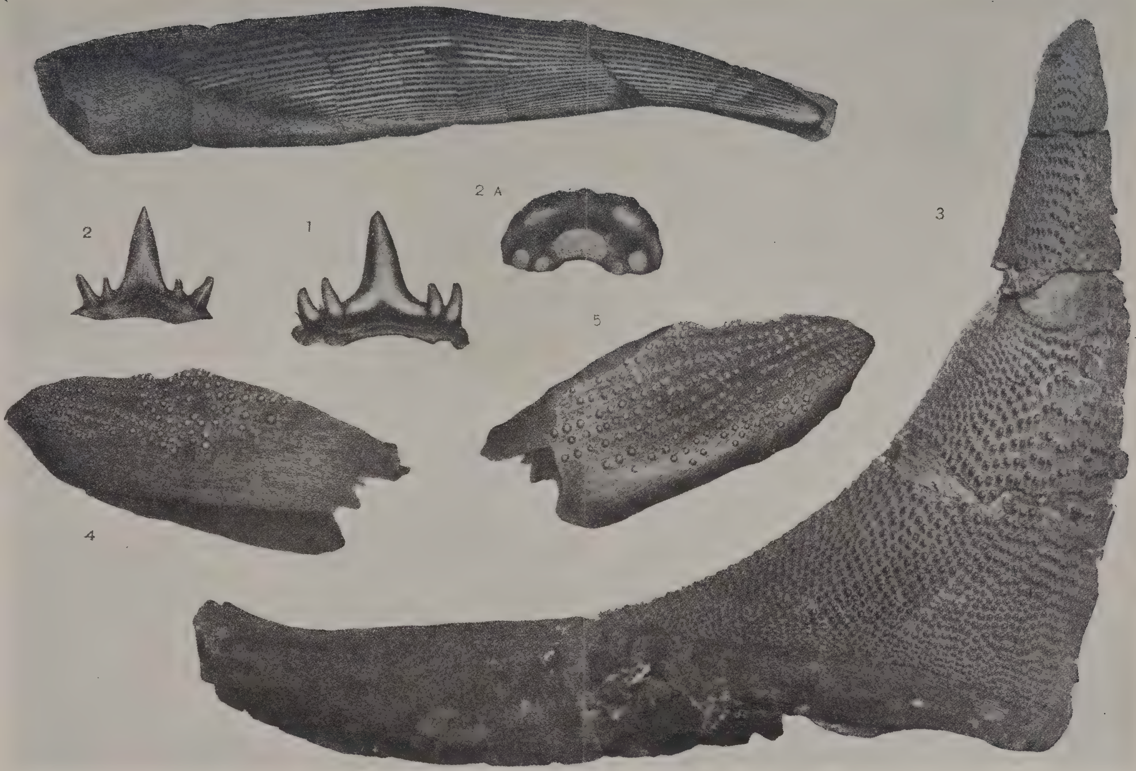

Fig. 39. Carboniferous spines *(ichthyodorulithes)* and teeth of sharks from rocks in the vicinity of Indiana.
1, 2, 2a: Shark's teeth of the genus, *Cladodus*.
3, 6: Fin spines of Mississippian sharks, *Oracanthus* and *Ctenacanthus*.
4, 5: Dentigerous plates of *Oracanthus*. After Newberry.

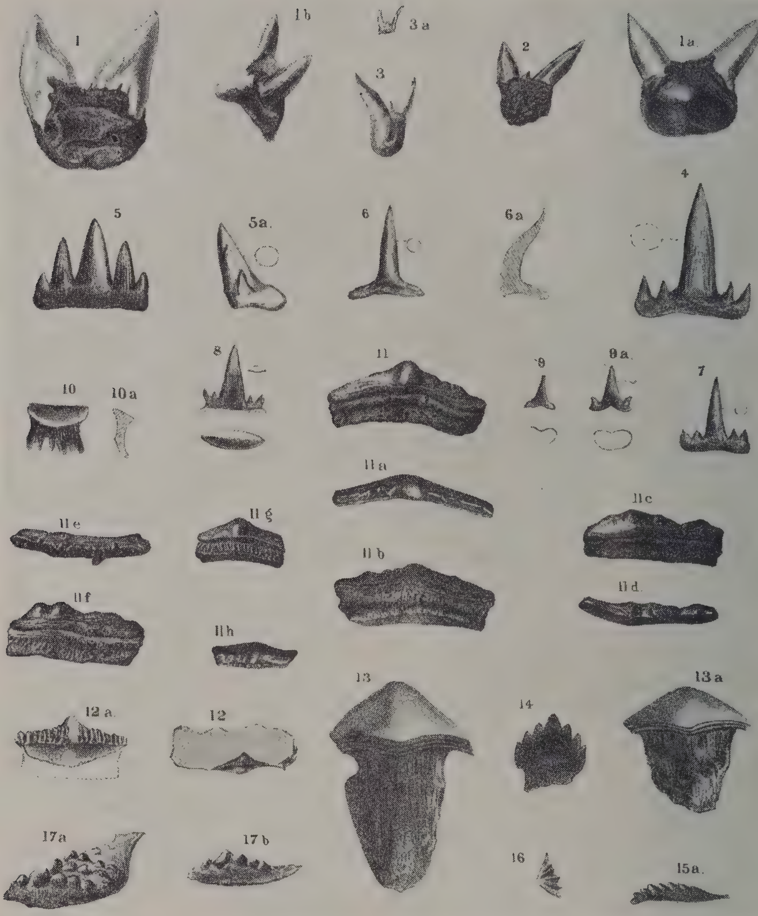

Fig. 40. Carboniferous shark's teeth of various forms. 1 to 3 represent the genus, *Diplodus;* 4 to 9 the genus, *Cladodus;* 10 to 14 five other genera. The teeth are usually found separate and there is little to show whether or not several of the species here shown represent a single fish. After Newberry.

Occasional discoveries enable us to correlate the scattered and variously named parts. Hundreds of species have been named from teeth and spines.

The known teeth (see papers by Branson in Bibliography) indicate a widely divergent mode of life. Some appear to have been fiercely carnivorous, with sharply pointed and cutting teeth, useful for retaining slippery prey as well as rending it into pieces small enough to be swallowed. Others with flat, quadrate, roughened plates appear to have been adapted to feeding on molluscs or crustacea, like the modern skates and rays, in which the chewing or crushing surfaces are covered with thin broad plates.

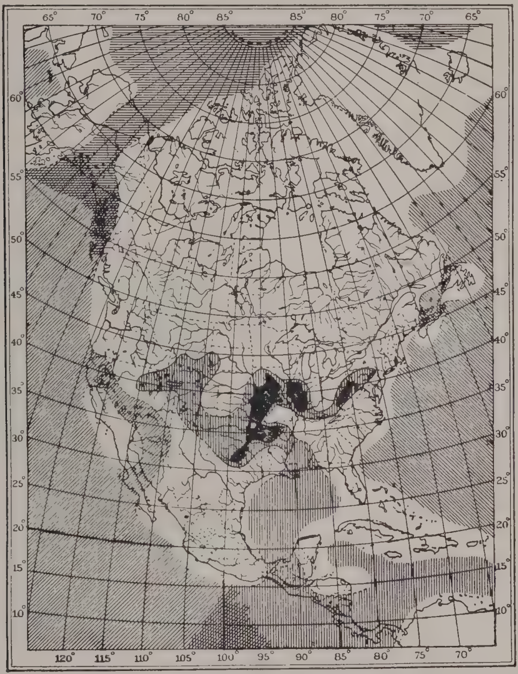

Fig. 41. Paleogeographic map of North America, showing distribution of land and water during the Pennsylvanian period. After Schuchert.

The ancient sharks, rays, skates, and their kin were, during the Carboniferous, dwellers in the open seas, very much as such animals live at the present time. The marine waters of the Carboniferous seas were plentifully supplied with hosts of invertebrates, an abundant food supply for the marauding sharks. None of the selachians were noted for unusual size. They were doubtless all moderate in dimensions, and are on the whole exceeded by modern species. During all subsequent time the elasmobranchs have changed but little. Their organization was fully established before the Coal Period ended.

Another group of cartilaginous fishes, the *chimaeroids*, shy and elusive as at present, inhabited ocean waters, and left their *tritors* as indicative of their presence.

The *Ostracoderms* and the *Arthrodires*, dominant types of the Silurian and Devonian, became extinct early in Carboniferous time, or shortly before its opening.

Lung-fishes continue their existence in the fresh-waters of the Carboniferous, and are known from their characteristic dental plates (Figure 33), incomplete skulls, and more or less complete remains. These are usually found in soft coal, associated with amphibians, and tell us that the dipnoans have not changed their habits of life since the great Coal Period.

The *Crossopterygians* (Figures 34, 35, 36) persisted from the Devonian throughout all subsequent geological time. There are a few genera and species known from the Carboniferous deposits, and a thin line carries the group to the present day, when the group is scantily represented.

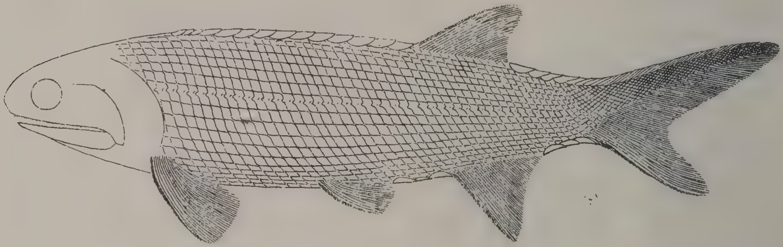

Fig. 42. Restoration of a primitive sturgeon, *Paleoniscus*, from the Carboniferous. After Lambe.

A family of enamel-scaled fishes, the *Paleoniscidae*, (Figure 42) began their existence in the Devonian as rather small fishes, and continued throughout the Carboniferous, to be represented today by the familiar sturgeons. An interesting item is the fact that in many places in Kentucky, Kansas and Iowa, heads of these fishes are preserved in small phosphatic nodules exhibiting in marvelous perfection the cartilaginous brain-box, the myodome,* the brain,† nerves, blood-vessels, eye, and other soft parts.

A single small species of the family Platysomatidae, known from the Coal Measures at Mason Creek, Illinois, seems to indicate the beginnings of the bony fishes which form such a diverse and abundant group among modern fishes.

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* Watson, D. M. S., 1925. The Structure of certain Palaeoniscids and the relationships of that group with other bony fishes. Proc. Zool. Soc. London, 815-870, 30 figs., 2 pls.

1928. On some points in the Structure of Paleoniscidae and allied fish. *Ibid.*, pp. 49-70, 15 figs.

† Moodie, Roy L., 1915. A new fish brain from the Coal Measures of Kansas, with a review of other fossil brains. J. Comp. Neurol., xxv:135-181, illus.

THE AMPHIBIANS AND REPTILES OF THE GREAT COAL PERIOD

There are no known remains of land vertebrates, tetrapoda, from the Carboniferous of Indiana itself, but in the adjoining states of Illinois, and especially in eastern Ohio and in Pennsylvania hundreds of incomplete skeletons of small early land vertebrates have been discovered in the cannel coal, and in nodules contained within the shales. None of these tetrapods of the Coal Period exceeded five feet in length and the great majority of them were less than a foot in length. Two species less than two inches long are known from the Mazon Creek, Illinois, shales. No new discoveries of Carboniferous amphibians have been made for many years, and much remains to be learned of the anatomy of the one hundred species so far described from the Coal Measures.* Two species are very fully known, even to some of the soft parts, but the fauna is known largely from fragments.

The science of *Ichnology,* the study of fossil footprints, has added a great deal to what we already knew about the tetrapods of the Coal Period, but so far no one has been able to correlate footprints with species known from skeletal remains. Ichnology is of importance in enabling us to learn a little of the activities of some of the creatures of the Coal Period. They tell us something of the size of these earliest land vertebrates which we would not otherwise know. Enormous tracks, nearly as large as those of the elephant, are known from Kansas, and tiny tracks elsewhere give the range in size and but little else. One trackway (Figure 43) of a Carboniferous tetrapod, as he walked along the wet sandy shore, will suffice to show their nature.

The amphibians of the Coal Period may be divided into two great groups, called the Branchiosauria and the Microsauria. A third group, the Salientia or frogs, is indicated by a single specimen, *Pelion lyelli,* (Figure 45) from the Ohio Coal. A similar distribution of type is shown by the Carboniferous species known from Europe, and the species of the two hemispheres are so similar that paleontologists think there must have been a community of origin of these small swamp dwellers. A migratory pathway must have existed during early Carboniferous times across the northern Atlantic, to explain the known distribution of the fossil faunas of the American Coal Measures.

The Branchiosauria (Figure 44) were the ancestral salamanders, and like modern salamanders, were largely aquatic, though capable of living in damp localities, acquiring their supply of oxygen either by pulmonary respiration, or by aeration through the walls of an expansive pharynx. Doubtless they fed on small animals and especially on minute aquatic plants. The group lived the greater part of their lives in shallow fresh-water pools or lagoons, in swampy areas filled with plant growth to the extent of furnishing material for the huge coal beds of the period. These ancient salamanders occur in some numbers in Carboniferous rocks of western Europe, but in America there are only a very few small species found in Mazon Creek, Illinois, nodules.

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* Moodie, Roy L., 1916. The Coal Measures Amphibia of North America. Publ. 238, Carnegie Inst. Wash., pp. 1-222, illus.

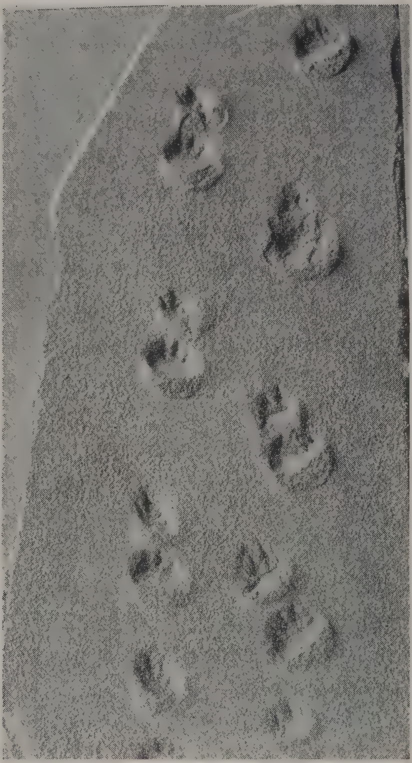

Fig. 43. Footprints of a land vertebrate (amphibian?) from the Lyons sandstone of Colorado (Coal Measures), showing nature of feet of an animal which is otherwise unknown. The subject of Ichnology yields important and interesting, but unsatisfactory, results. Similar tracks are known from Ohio and in the Permian of Arizona. Photograph by Henderson.

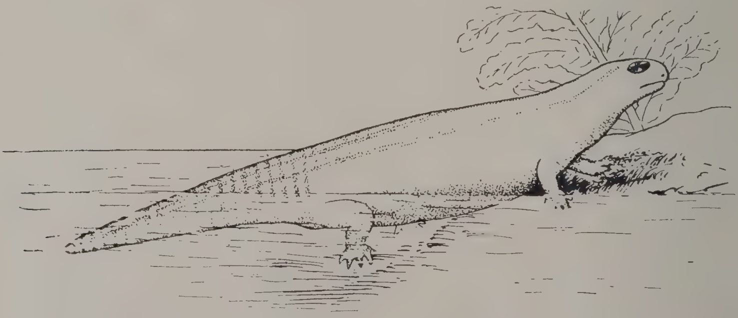

Fig. 44. Restoration of an American branchiosaur, *Micrerpeton caudatum* Moodie, based on a very complete material showing form of body, pigment of eye, impressions of skeleton, lateral line organs, tail membrane and in a related species the impress of the liver and form of the entire alimentary canal. Length of fossil slightly less than two inches. Type from the Mazon Creek shales, Illinois, preserved in Walker Museum, University of Chicago. This animal was one of the ancestors of our modern salamanders.

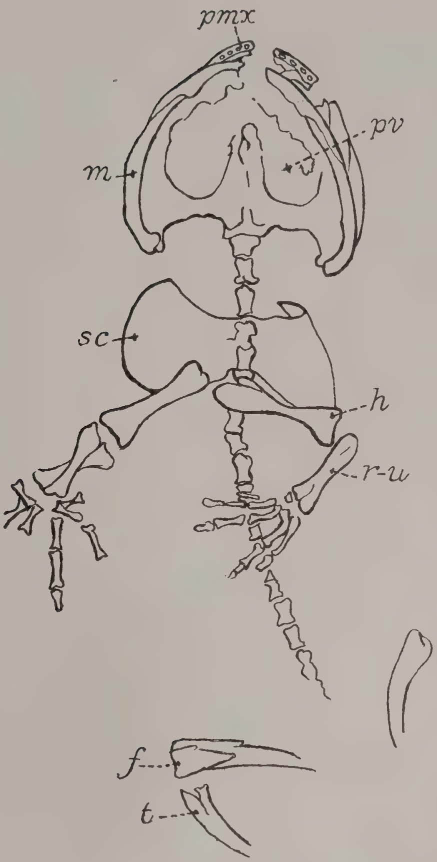

Fig. 45. A possible ancestor of the modern frogs, known as *Pelion lyelli* Wyman, from the Coal Measures of Ohio. The various skeletal parts are characteristic of the frogs.

h, humerus; m, mandible; pmx, premaxilla; pv, palatine vacuity; r-u, radius-ulna, conjoined; f, femur; sc, scapula; t, tibia.

On account of their habit of life the branchiosaurs had retained certain structures which are thought to be present only in fishes. Small cycloid scales covered the body, and in the skin of the sides of the body and on the head were present sensory organs of the lateral line system which enabled them to beware of danger because the lateral line organs were capable of perceiving slow wave vibrations. Otherwise they were deaf. Large eyes placed on top and sides of the head probably made perception by sight very good. The position of the eyes indicate that the branchiosaurs were bottom feeders, although the ventral surface was protected by intramuscular rods of cartilage. On top of the head, too, there is that remarkable perception organ—the pineal eye, functioning as heat perceptor. This organ is well developed in all Coal Measures vertebrates in which the head is well preserved. The creatures were voiceless, and were totally unable to protect themselves, except by hiding, and choosing quiet ways of living. They were timid, retiring adventurers in the world of life, but we believe they are the ancestors of our modern salamanders.

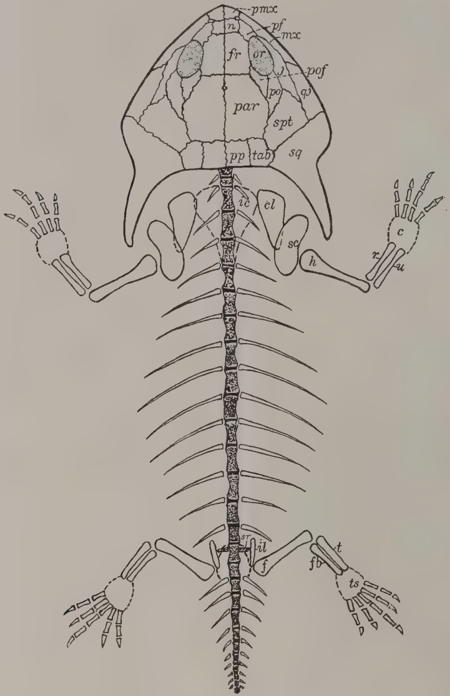

Fig. 46. Restoration of one of the small (about six inches long) reptile-like amphibians known as the Microsauria. The presence of horns was common to microsaurians of Europe and America (Ohio). c, space for cartilaginous carpus; cl, clavicle; f, femur; fb, fibula; fr, frontal; h, humerus; il, ilium; ic, interclavicle; j, jugal; mx, maxilla; n, nasal; or, orbit; pf, prefrontal; par, parietal; pmx, premaxilla; po, postorbital; pof, postfrontal; pp, postparietal; qj, quadratojugal; sq, squamosal; spt, temporal; sc, scapula; sr, sacral rib; tab, tabulare; t, tibia; r, radius; u, ulna; ts, tarsus. Based on material preserved in the United States National Museum.

The Microsauria were the active, reptilian, pugnacious vertebrates with a way to make in the world, and they made it. Representative microsaurians are found abundantly in western Europe, in Nova Scotia and in Ohio—a distribution difficult to understand. Many small groups of creatures are comprised in the order called Microsauria. They may have survived until near the close of the Permian (Figure 46), but their life was largely lived during the Carboniferous. There has been a suggestion that the Microsauria were ancestors to all of the reptiles, but the probabilities are that the reptiles and the microsaurians were derived from the same stem, a primitive group at present unknown.

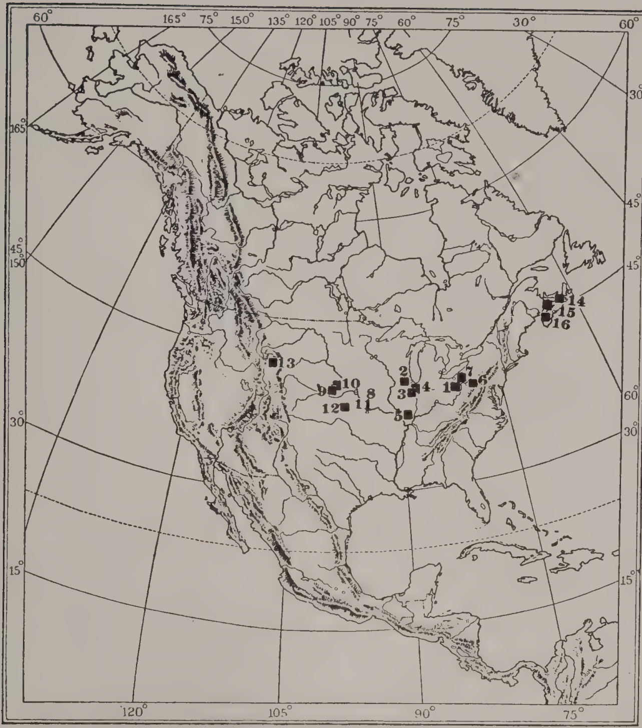

Fig. 47. Map of North America showing localities where amphibians have been found in the Coal Measures.

We are sure that the microsaurian fauna as known from the Coal Measures are the diversified results of a long preceding line of evolutionary groups, of which we know nothing. The Microsauria were extremely specialized, showing Nature's efforts to attain a successful condition. Some of them, *Ptyonius,* were quite snake-like with the bodily parts reduced to a slender, elongate vertebral column, a head and small pectoral plates. Some, *Hylonomus,* were quite lizard-like, with small sharp claws and active bodies, finding their easy mode of life within the forests of sigillarians, totally removed from an aquatic habitat. Others, broad and squat, lived a stupid existence along the water's edge, while some, with long vertically flattened tails were expert swimmers. Such diverse modifications had been attained before the Coal Period, since these types are common alike to Ireland and Ohio.

The frog group, the Salientia (Figure 45), is represented, or rather suggested, by a single incomplete specimen, named *Pelion lyelli* by Wyman. This is an imperfect skeleton picked up three-quarters of a century ago from the mine dump in eastern Ohio. Among the hundreds of skeletal parts subsequently collected not a fragment can be assigned to this species. *Pelion lyelli* has the broad flat head of a frog with large

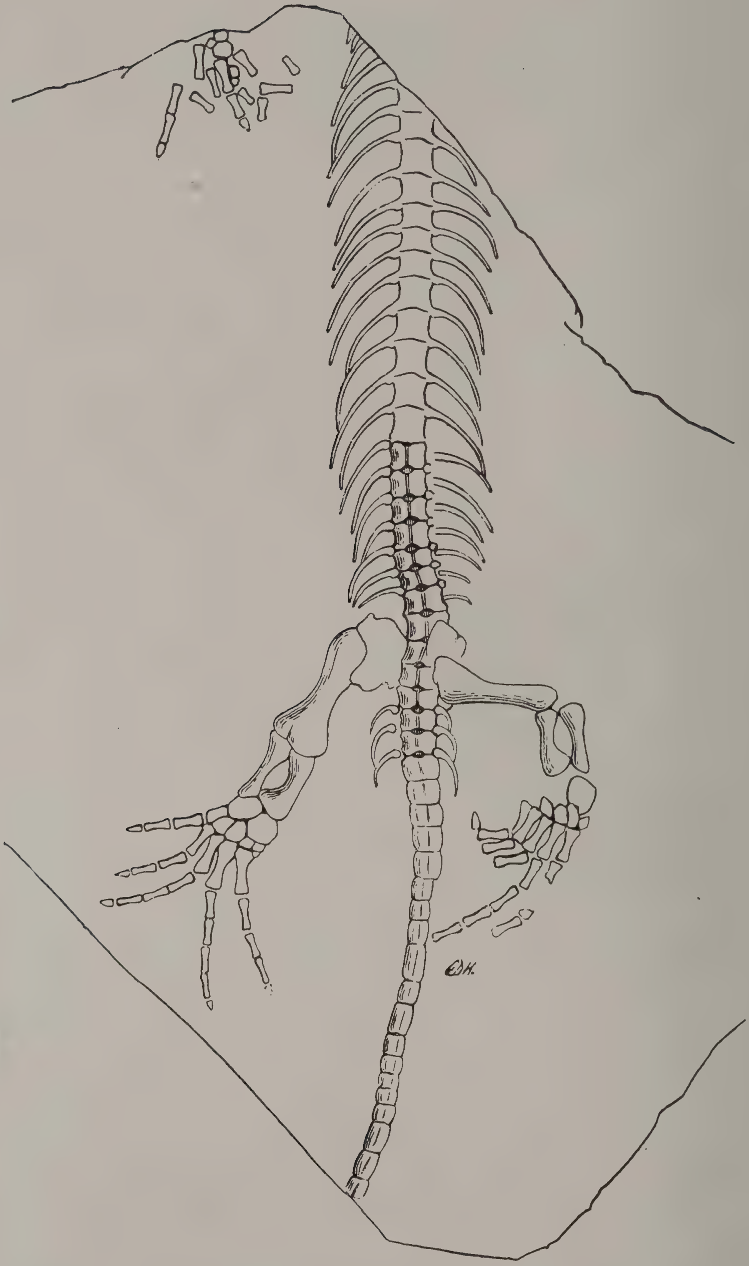

Fig. 48. Outline drawing of the skeletal parts of the "oldest known reptile," *Eosauravus copei* Williston, from the Coal Measures of Ohio. Specimen in U. S. National Museum. About natural size.

palatine vacuities: short, squat, heavy fore limbs, with radius and ulna fused, as in modern frogs: with long hind legs, though incomplete. The skeleton furnishes a suggestive picture of an ancestral frog, and as such we shall regard it until something more of its structure is known. No European species resembles it in any way.

The true reptiles are indicated by a single incomplete skeleton (Figure 48) from the Coal Measures of Ohio, designated as *Eosauravus copei* by Williston. A detailed account of this species* reveals many specialized features of which we do not now know the origin. The important characters of the cranium are unknown, because the body is broken at the neck, but the remainder of the skeleton reveals microsaurian characters of the greatest interest. The creature was about six inches in length, and lived an aquatic or subaquatic life, if we interpret the broad osseous tarsus and foot correctly. If we could learn more of the structure of the group of reptiles to which this species belongs, we would be in a fair way to understand the transition from the microsaurian Amphibia to the reptiles, for assuredly *Eosauravus* partakes of the qualities of both groups.

An important characteristic of nearly all the Paleozoic Amphibia is the presence of a ventral armature of cartilaginous or even osseous rods, embedded in the abdominal musculature, in the myocommatous septa. This is lacking in *Eosauravus,* but this is of no especial consequence since the character is an extremely variable one. Among some of the Permian species the ventral chevrons formed a veritable armature.

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* Moodie, Roy L., 1909. Carboniferous air-breathing Vertebrates of the United States National Museum. Proc. U. S. Natl. Museum, vol. 37, pp. 11-16, plates 4 and 5.

PERMIAN VERTEBRATES IN THE NEIGHBORHOOD OF INDIANA

The Permian witnessed the closing of the Paleozoic, and it was marked by widespread arid climates and saw vast changes in the nature of the vertebrates. During this period the stem groups of the birds and mammals were evolved, many archaic forms became extinct, and bizarre forms arose and passed away. The period has been studied especially by Williston, Case,* Cope, and others. The rocks of the period throughout the world are predominantly red, and the term Red Beds has come to indicate the Permian, although red rocks are known in other periods.

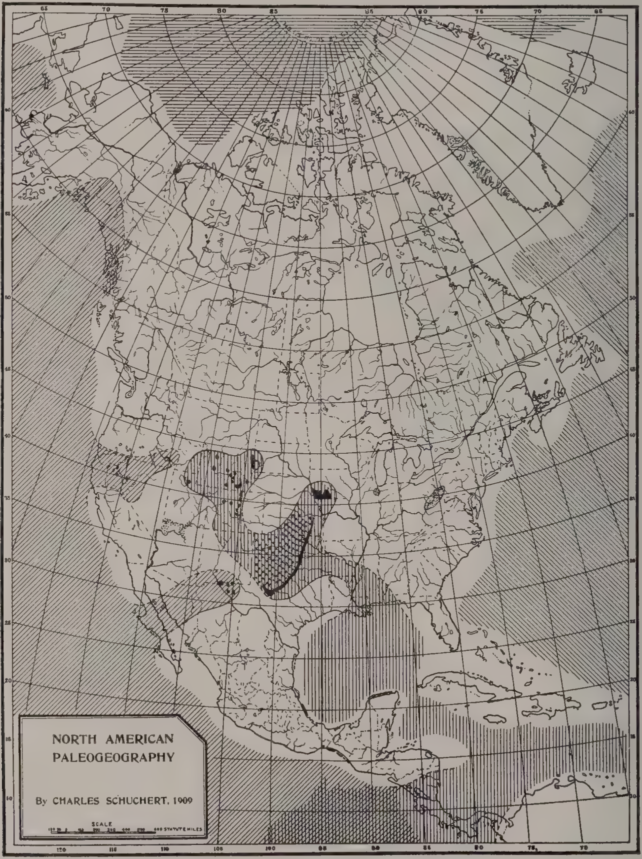

Fig. 49. Paleogeographic map of North America showing land and water during the lower Permian. Attention is particularly called to the small Permian localities on the east and on the west of Indiana. After Schuchert.

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* Case, E. C., 1915. The Permo-Carboniferous Red Beds of North America and their Vertebrate Fauna. Publ. 207, Carnegie Institution of Wash.

The map (Figure 49) shows two small Permian localities, one in Illinois near the western Indiana line and the other in western Pennsylvania. Other deposits are known in West Virginia,* Kansas, Oklahoma, Texas (the most extensive deposits in America) and New Mexico.

The deposit on Salt Fork Creek in eastern Illinois, near Danville, is less than forty square feet all told. The writer was sent to this locality in 1907 by Dr. Williston to see if further material was to be found, but a week's excavation resulted in a mere handful of bones. Similar conditions doubtless exist in the Pennsylvania deposits† where fragments only have been discovered. The Kansas deposit is of small extent. These small fragmentary faunas are only to be understood‡ by reference to the more complete information derived from the deposits in Texas.

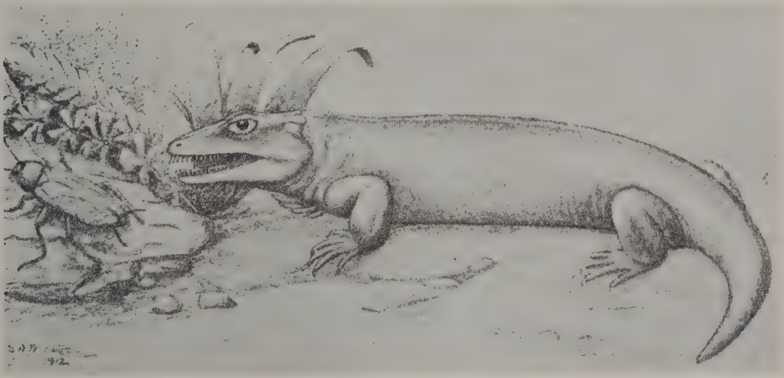

Fig. 50. A Permian reptile from the Red Beds of Texas. After Williston.

A glance at the nature of the vertebrate fauna of the Permian shows the startling physiographic changes which had been wrought during the close of the Paleozoic epoch. Fully two-thirds of the North American continent had emerged from the sea, never again to be so completely inundated. Epicontinental seas of slight depth did come up, during the Cretaceous, from what is now the Gulf of Mexico, but after the Paleozoic the land mass remained essentially what it is now. The influence of this change in environment is clearly seen on the vertebrates from the Permian.

Marine vertebrates are indicated by the eight species of sharks which are known and possibly other incompletely known species. Several lung-fishes of different genera indicate the fresh-water life, as do the scant remains of other fishes.

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* Tilton, John L., 1926. Permian Vertebrates from West Virginia. Bull. Geol. Soc. Amer., vol. 37, pp. 385-396, pl.

† Case, E. C., 1908. Description of vertebrate fossils from the vicinity of Pittsburgh, Pennsylvania. Annals Carnegie Museum, iv, 234-241, pl.

‡ Case, E. C., 1911. Revision of the Amphibia and Pisces of the Permian of North America. Publ. 146, Carnegie Inst. Wash. Also other volumes on Cotylosauria, Pelycosauria, etc.

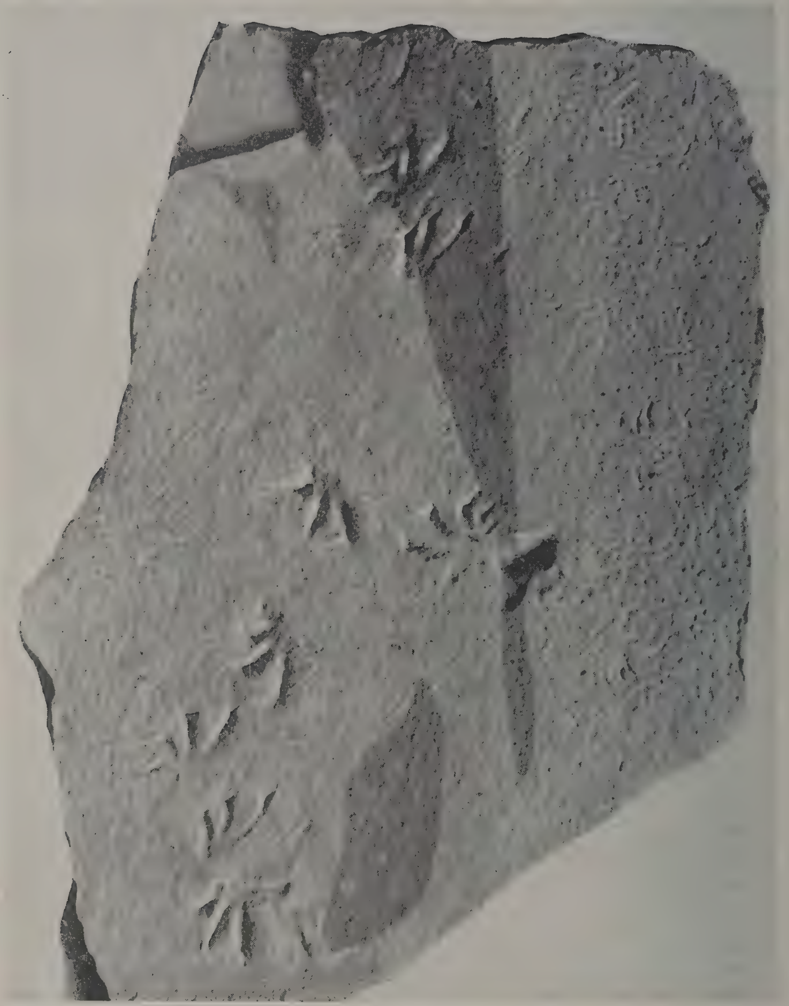

Fig. 51. Where animals walked when the world was young. Footprints of an insect, to the right, and tracks of a small reptile-like amphibian, to the left, as seen on a slab of bright red (shown dark in the photograph) and gray (the lighter áreas) shale collected on the north slope of Castle Peak, ten miles due south of Merkle, Texas. These fossil footprints are the tracks of one member of a new fauna, soon to be described from the Red Beds.

The land vertebrates, however, are the most significant and their diversity of structure indicates a rapidly evolving group from which later vertebrates were to arise. The nature of the evidence is that of thousands of petrified bones and footprints (Figures 50, 51). Skeletons of these early vertebrates, sufficiently complete for mounting (Figure 52) are preserved in Walker Museum, University of Chicago, at the American Museum of Natural History, at the Peabody Museum, Yale University, in the University of Michigan and elsewhere. These skeletons represent stegocephalian Amphibia; possibly salamanders and other diverse groups now extinct.

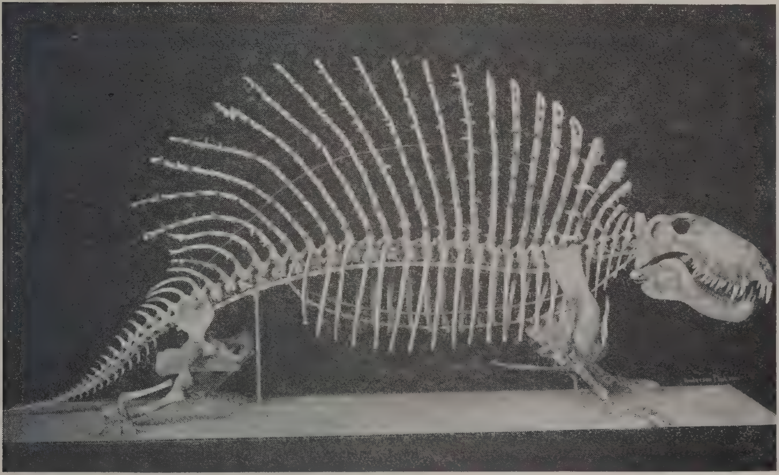

Fig. 52. Mounted skeleton of a Permian long-spined reptile in the American Museum of Natural History. Fragments indicate the presence of this, or a similar form, in the Indiana region.

The stegocephalians are of the greatest interest, and one form, *Eryops*, was almost as large as the Triassic labyrinthodonts. The anatomy of the skeleton is very completely known, and a mounted skeleton has been on exhibition for some time. Some of the fragments found in Pennsylvania are related to this large creature. A common peculiarity of the Permian amphibians was the roofed-over cranium, hence the term *stego-cephalian,* meaning roof-headed.

One of the species of Permian vertebrates found in the deposit at the Illinois-Indiana line was a curious creature called *Diplocaulus* (Figure 53). This animal has been fully described by Douthitt* in a posthumous paper edited by S. W. Williston. The shape of the skull, drawn out into long horns, is extremely odd (Figure 53) even in a fauna of many curious forms. The vertebral column was long and slender, and the limbs were very weak. Douthitt regards the animal incapable

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* Douthitt, Herman, 1917. The Structure and Relationships of Diplocaulus. Contributions from Walker Museum, vol. 11, no. 1, pp. 1-41, 2 plates, 6 figures.

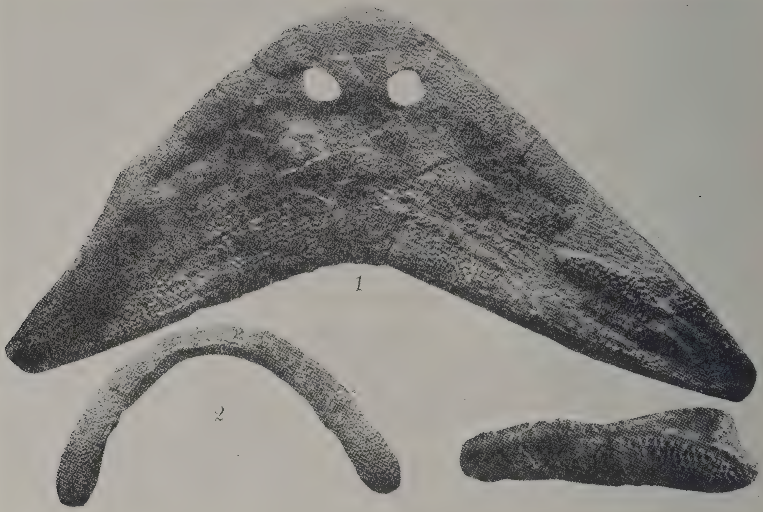

Fig. 53. Skull and jaws of a peculiar Permian vertebrate, *Diplocaulus*, from the Red Beds of Texas.

of moving on dry land, nor could it have lifted its head out of an aquatic medium, where it was doubtless a bottom feeder, rising at intervals to the surface of the water to gulp air.

The reptiles (Figure 52) were the highest vertebrates of the Permian, and the group is represented by scores of species.† When we consider the few (possibly only one) species of reptiles which are known from the great Coal Period, we may well be surprised at the vast expansion of Reptilia during the dry, warm Permian. We do not yet know the progenitors of all of the Permian reptiles, but we are sure that most of the diverse groups became extinct before the opening of the Triassic. Case* has reviewed the evidences of conditions under which the Permian reptiles lived. The land life of the period came suddenly and completely to an end in North America. Where the species came from and why they disappeared are among the many unsolved problems of paleontology.

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† Williston, S. W., 1914. The Age of Reptiles in "Water Reptiles of the Past and Present." Chicago, Chapter IV. American Permian Vertebrates. Chicago. Osteology of the Reptiles. Cambridge. Papers in Journal of Geology.

* Case, E. C., 1919. The Environment of vertebrate life in the late Paleozoic in North America: a Paleogeographic Study. Publ. 283, Carnegie Institution of Washington.

TRIASSIC VERTEBRATES IN EASTERN STATES AND IN THE FAR WEST

The series of deposits of Mesozoic and Cenozoic age, elsewhere enormous, are entirely wanting in Indiana. This is due to the imperfection of the geological record. While the surface of what is now Indiana was above water from the close of the Coal Measures to the present time no water-borne deposits were accumulated. Whatever river deposits or lake sediments may have accumulated in Indiana during these long periods of time were either eroded or covered by the vast amount of glacial material brought in during the great Ice Age. Such being the case, and in order to complete our picture of vertebrate development, it is necessary for us to look elsewhere for evidences of Triassic vertebrates.

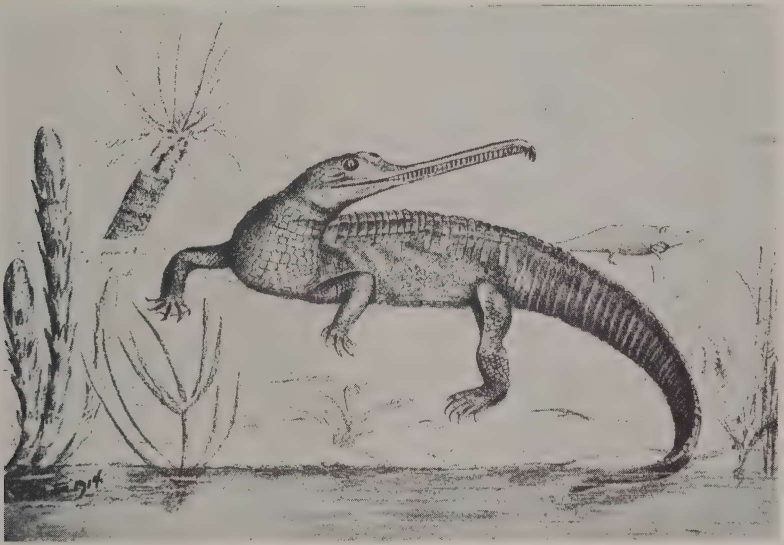

Fig. 54. A Triassic landscape with a long-snouted phytosaur in the foreground, and a characteristic labyrinthodont behind. The phytosaurs were crocodile-like in appearance, but more like the dinosaurs in structure. The nostrils were placed immediately in front of the eyes. The group is known exclusively from the Triassic. After Williston.

In the eastern states of New Jersey, Massachusetts, Connecticut and Pennsylvania occur the Newark series of rocks, of Triassic age, which bear abundant evidences of the vertebrate life of the times. In the far western states of Wyoming, New Mexico and Texas occur Triassic deposits containing remains of upland and semi-aquatic vertebrates. Marine Triassic deposits containing aquatic reptiles otherwise and elsewhere unknown, and which are of the greatest interest, are found on the Pacific Coast.

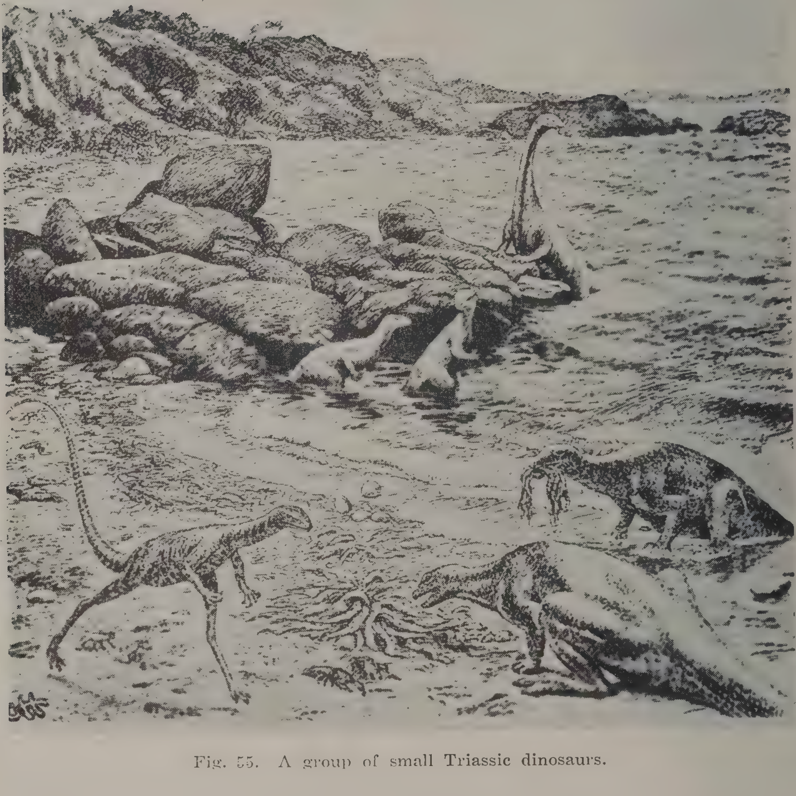

Fig. 55. A group of small Triassic dinosaurs.

Triassic fishes have long been known in abundance* from the Newark series and the general account of fish development is known.†

The amphibians of the Triassic were the huge, unwieldy labyrinthodonts which were worldwide in distribution and which became totally extinct before the close of the period. Their heavy heads are found in Pennsylvania, Wyoming** and Texas.†† These creatures were the terminal forms of a long line having their origin in the early Carboniferous.

The subject of *Ichnology*, the study of footprints, was founded on an attempted interpretation of tracks found in the Triassic rocks of the Newark series. A large number of species have been named and numerous attempts have been made to correlate footprints and skeletal remains.‡

The reptiles of the Triassic were of an expanding plastic type and they foreshadowed the coming of later groups. Dinosaurs (Figure 55) of small size and active habits occur in the Triassic rocks where their remains are associated with those of phytosaurs and labyrinthodonts.¶ In the deposits of Wyoming‖ occur several species of phytosaurs (Figure 54). The marine triassic rocks of the Pacific coast carry remains of ichthyosaurs§ of a primitive type.

Mammals and birds are unknown during Triassic times, although mammal-like reptiles occur in foreign deposits.

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* Eastman, Charles R., 1904. The Triassic Fishes of New Jersey. Geol. Surv. N. J., Rept., pp. 29-102, 14 plates.

Eastman, Charles R., 1911. Triassic Fishes of Connecticut. Bull. 18, Geol. Surv. Conn., pp. 1-75, 11 pls.

† Eastman, Charles R., 1912. Mesozoic and Cenozoic Fishes. Bull. Geol. Soc. Amer., vol. 23, pp. 228-232.

** Branson, E. B., 1905. Structure and Relationships of the American Labyrinthodontidae. Journ. Geol., xiii, pp. 568-610, figs. 1-19.

†† Case, E. C., 1922. New Reptiles and Stegocephalians from the Upper Triassic of western Texas. Carnegie Inst. Wash., Publ. No. 321.

‡ Lull, R. S., 1915. Triassic Life of the Connecticut Valley. Bull. 24, Geol. Surv. Conn., pp. 1-285, 124 figs.

¶ Huene, F. von, 1921. Reptilian and Stegocephalian Remains from the Triassic of Pennsylvania in the Cope Collection. Bull. Amer. Mus. Natl. Hist., xliv, 561-574, illus.

‖ Mehl, Maurice G., 1915. The Phytosauria of the Trias. Journ. Geol., xxiii, 129-165, 20 figs.

§ Merriam, John C., 1908. Triassic Ichthyosauria, with special reference to the American forms. Mem. Univ. Calif., Vol. 1. pp. 1-196, 18 plates.

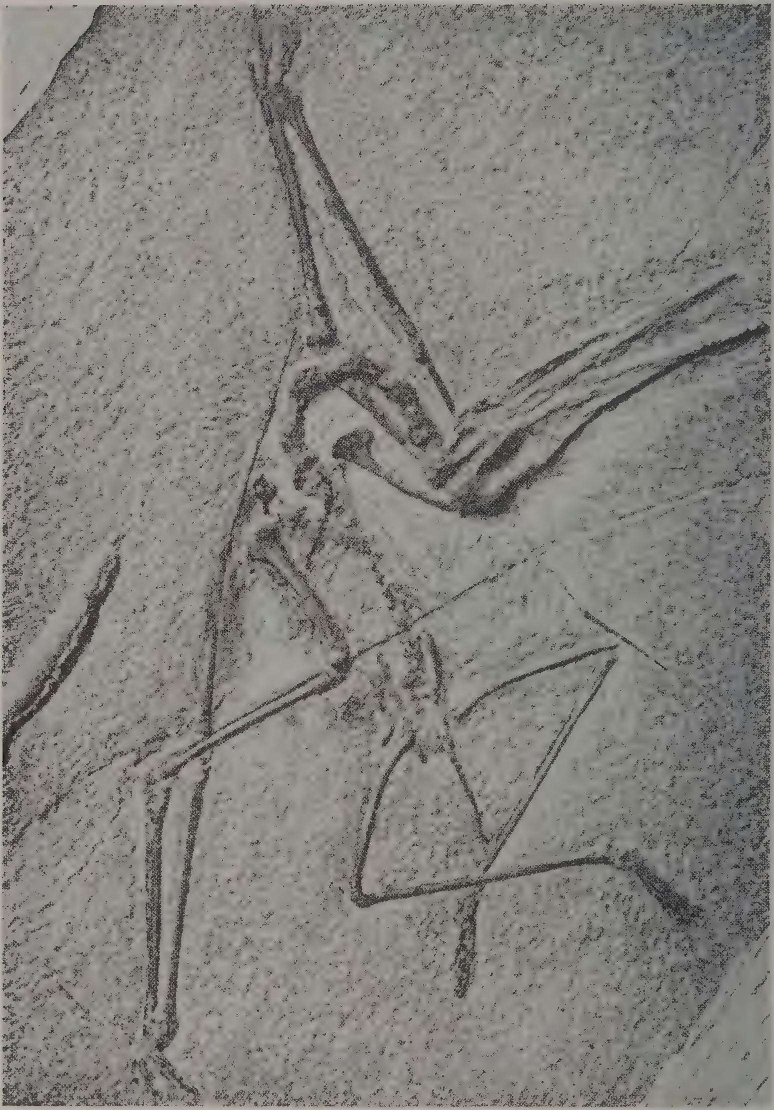

Fig. 56. Skeleton of a small flying reptile, pterodactyl, *Pterodactylus micronyx* H. v. Meyer, from the Jurassic lithographic slates of Bavaria. Somewhat reduced. After Broili.

ADVANCEMENT OF THE VERTEBRATE GROUPS DURING THE JURASSIC AND COMANCHIAN IN AREAS OUTSIDE OF INDIANA

The greatest advances made in vertebrate life with the opening of the Jurassic were those concerned with the origins of the birds and mammals. Nowhere in America is the vertebrate life of the Jurassic pictured so clearly as it is in the lithographic slates of Europe.* Creatures otherwise unknown are preserved in startling perfection (Figures 56, 57). The following list of papers will be of service to those seeking further information:

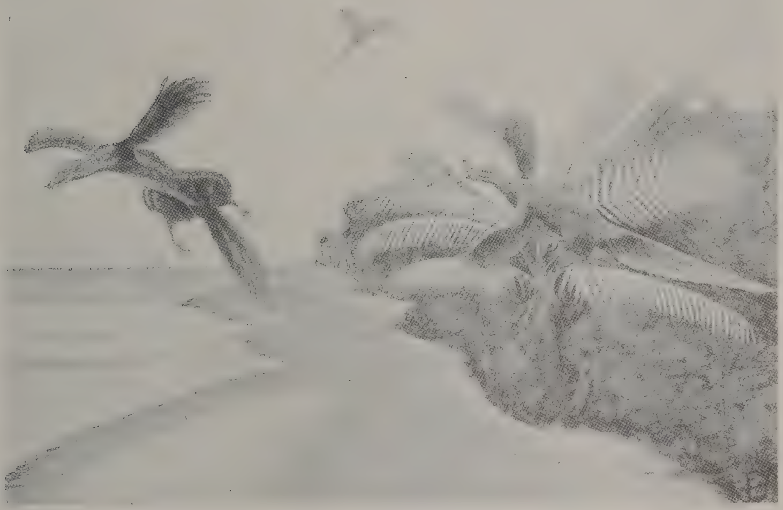

Fig. 57. The Jurassic, reptilian bird whose remains occur in the slates of Solenhofen, Europe. The bird was the size of a crow. A pterodactyl is in the air beyond the birds. After Berry.

Osborn, H. F. 1915. Close of Jurassic and Opening of Cretaceous time in North America. Bull. Geol. Soc. Amer., vol. 26, 295-302.

——— and Mook, C. C. 1919. Characters and Restoration of the sauropod genus Camarasaurus Cope. Proc. Amer. Philos. Soc., lviii, 386-396, 3 figs.

Schuchert, Charles. 1918. Age of the American Morrison and East African Tendaguru Formations. Bull. Geol. Soc. Amer., vol. 29, 245-280.

Lee, Willis T. 1915. Reasons for regarding the Morrison an introductory Cretaceous Formation. Ibid., vol. 26, 303-314.

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* Berry, Edward W., 1918. The Jurassic Lagoons of Solnhofen. Scientific Monthly, October, 361-378, 5 figs.

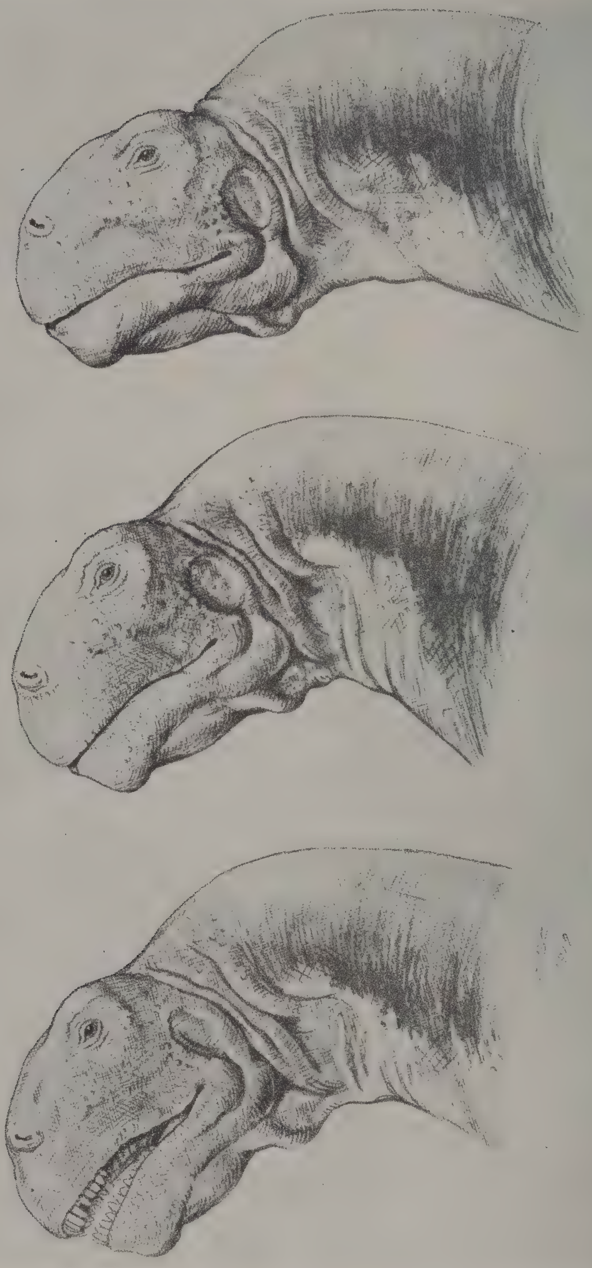

Fig. 58. Three studies of the head of a sauropod dinosaur, *Camarosaurus*, by Osborn and Mook, based on material in the Cope Collection in the American Museum of Natural History.

A, head extended and bent upwards. B, neck flexed and head bent downwards. C, neck flexed and head bent strongly downwards to show ground-feeding pose and to expose the teeth. This creature was one of the gigantic, quadrupedal, upland dinosaurs.

Lull, R. S. 1915. Sauropoda and Stegosauria of the Morrison of North America compared with those of Europe and eastern Africa. Ibid., vol. 26, 323-334.

The archaic mammals of the time were small creatures, a few inches in length, incompletely known, and all the known forms appear to belong to the primitive group Multituberculata, and all were probably egg layers.

THE VERTEBRATES OF THE GREAT CRETACEOUS INLAND SEAS

The land and water areas, all represented far away from Indiana, of the long Cretaceous period acquired sediments in which all of the vertebrate groups have been found. It will be convenient to regard the land areas as those bordering on the great inland Cretaceous sea which at one time connected the waters of the Arctic Ocean with those of the Gulf of Mexico. Deposits over 20,000 feet thick indicate the depth of the water and the duration of the period.

The fishes of the Cretaceous had lost nearly all of their archaic features and in general approach the structure of modern fishes, rather than the curious piscine forms we have been considering. There are no striking peculiarities about the Cretaceous fishes. They range through the sharks, chimaeroids, ganoid and bony fishes which after slight modifications gave rise to the aquatic vertebrates of today.

Amphibians are practically unknown from Cretaceous deposits, although frogs are known from the Jurassic. A salamander is indicated by scant remains, and it may be that the amphibians of the time were frogs and salamanders, as today.

The reptiles present an astonishing array (Figures 60, 61) in the air, in the water and on land. It will be profitable to review here some of the more important reptilian groups to show the extreme diversity of form, size and habitat.

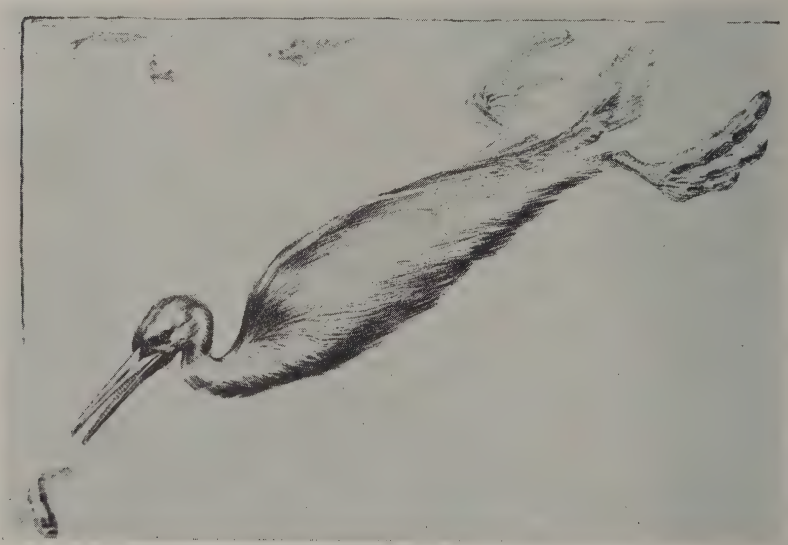

Fig. 59. The large, flightless, toothed, diving bird, *Hesperornis*, whose bones are found in the Cretaceous chalk of Kansas, pursuing a bony fish in the waters of the Niobrara Sea. After Lucas.

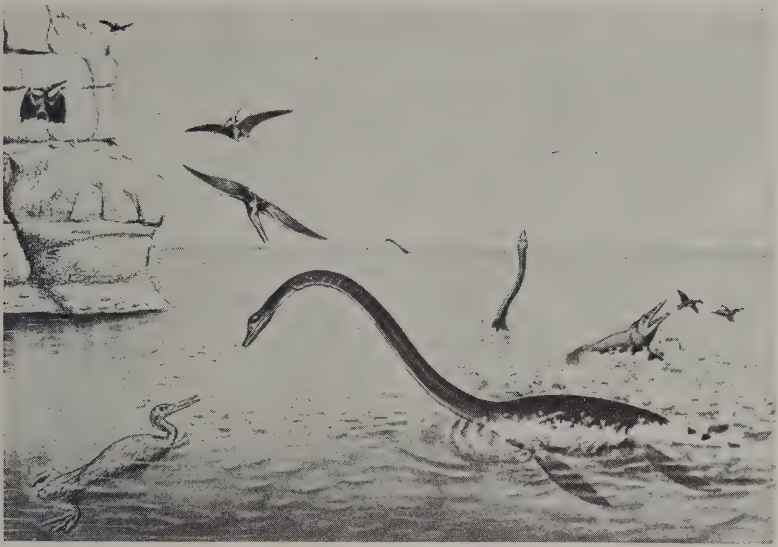

Fig. 60. An idealized, Cretaceous landscape, in western Kansas. A toothed diving bird and a long-necked plesiosaur in the foreground. Pterodactyls on the cliffs and in flight. A mosasaur attempting to capture a small flying bird, and two plesiosaurs in the background. After Williston.

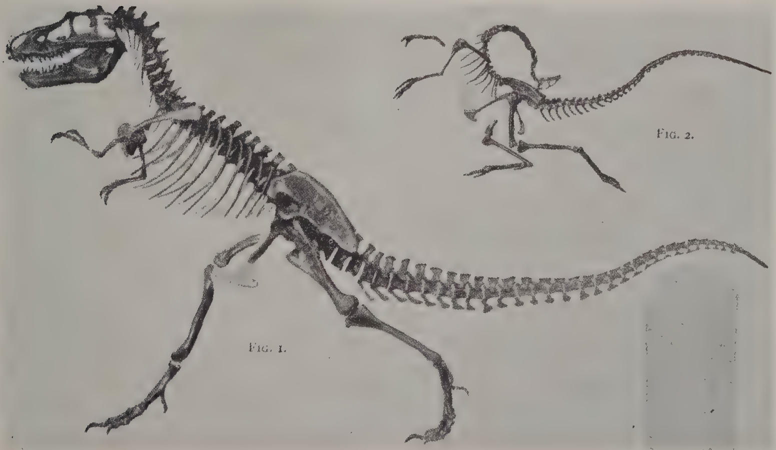

Fig. 61. Cursorial dinosaurs from mid-Cretaceous rocks of Canada. Fig. 1—*Gorgosaurus* a carnivorous dinosaur. Fig. 2—*Struthiomimus* a toothless, browsing, bipedal dinosaur, an offshoot from the carnivorus group. The skeleton is in the opisthotonic attitude as assumed during rigor mortis. After Osborn.

Turtles had arisen, somehow, during the early Cretaceous or Morrison, and in the upper Cretaceous show a diversity of form and size. One species from the chalk beds of Kansas attained a width of 12 feet across the front flippers.

Land lizards appear during the Upper Cretaceous but are scantily represented. The lizard group, however, the Sauria or Squamata, are represented by the large aquatic mosasaurs (Figure 60, background to right). These water reptiles attained a world-wide distribution, reaching a body length of forty feet. They are best known from the chalk beds of Kansas where thousands of specimens have been collected.

The Cretaceous crocodiles differed somewhat from the modern saurians. A few species were quite large, but none is very fully known.

A group of aquatic reptiles called the plesiosaurs were restricted to the Cretaceous. Their long, slender necks are characteristic of some of the members of the group (Figure 60), but some of them had short necks.

Flying reptiles called pterodactyls (Figure 60) are found associated with the marine reptiles in the chalk. Some of these volant saurians, with a wing expanse of 22 feet and a body weight of not more than 20 pounds, were the most highly adapted to life in the air of any of the pre-Tertiary vertebrates.

Dinosaurs of several types represent the land vertebrates (Figure 61). The dinosaurian reptiles of the Cretaceous were extremely diverse in structure and habit. They reached their maximum of expansion during this period and all of them became extinct at the close of the Cretaceous.

Birds of several types are known. One, a highly specialized wingless, toothed, diving bird (Figure 59) was the largest bird of the period. It was practically helpless on land. Another toothed bird, with strong wings, was about the size of the modern pigeon.

The Cretaceous mammals were all small, so small that the desert ants bring their teeth to the surface in their vast tunneling operations. It has been frequently suggested that these small creatures by feeding of dinosaur eggs brought about the extinction of that group of reptiles. The mosasaurs which may have laid eggs, and the plesiosaurs which gave birth to living young were immune to such attacks, yet neither group survived the Cretaceous.

MAMMALS OF THE TERTIARY OF NORTH AMERICA

Attention is directed particularly to the *mammals*, not because fishes, amphibians, birds and reptiles are unknown, but because the Tertiary was the *Age of Mammals*, during which, in areas outside of Indiana, surprising developments took place. We find mammals attempting life in the sea, in the trees, in the air, in holes in the ground, on upland grassy plains, in marshes, in forested areas and other habitats. They were extremely diversified as to structure, size and bodily proportions. Nature was reaching out in every conceivable direction to determine successful lines of mammalian development.* Since it is not possible in this paper to even outline the progress the mammals made during the Tertiary, I am showing, in the figures, the normal evolutionary sequences in the horses (Figure 62); a bizarre, extinct, unsuccessful, clawed, ungulate mammal (Figure 63); a view across the high plains of Nebraska, with the camps of the bone diggers near one of the most remarkable deposits of Tertiary mammals known anywhere in the world (Figure 64); and the process of recovering fossil mammals for study (Figure 65). These will give the reader a slight conception of the enormous amount of skill and scientific work required to reach our present knowledge of Tertiary Mammalia.

THE PLEISTOCENE OF INDIANA

It will not be necessary for us to go into details of the Pleistocene geology of the state in this place. This has been done by Hay, whose writings are listed in the Bibliography. It is important to emphasize here the fact that following the close of the Paleozoic, in fact after the Coal Measures, fossil-bearing deposits do not exist in Indiana until we reach the Pleistocene beds from which an abundant and interesting mammalian fauna is known. The entire stretch of geological time throughout the vast Mesozoic and the Cenozoic, constituting 15% of the history of the earth, is not represented within the state limits of Indiana.

The determination of the faunal divisions of the deposits in Pleistocene times† need not enter into the present discussion except to point out that there are successive stages in the glacial and interglacial times during which the mammalian life is recorded. Since most of the Pleistocene mammals known from Indiana were herbivores it will be of interest to call attention to what little is known about the plants‡ of Pleistocene age which lived in Indiana. In a general way the plants were then very much as they are now. That is, there were woody trees, grasses and flowering plants. The distribution of plant life which served as food for the Pleistocene mammals was of great importance in determining the localities where the fossils are found, modified of course by water action of glacial rivers and lakes.

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* Osborn, H. F., 1921. The Age of Mammals in Europe, Asia and North America. New York. pp. 1-635, 220 figures.

† Hay, O. P., 1912. The Recognition of Pleistocene Faunas. Smithson. Misc. Coll., 59, no. 20; 1-16, 10 maps.

‡ Knowlton, F. H., Plants of the Past. Berry, E. W., Tree Ancestors.

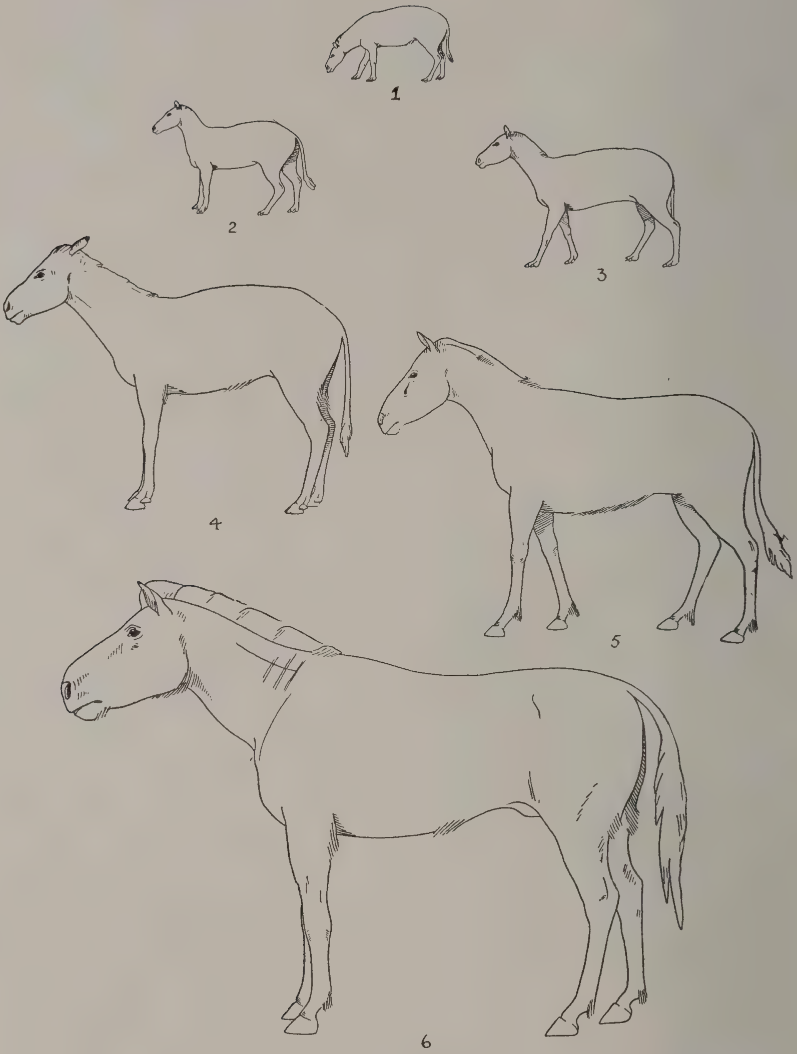

Fig. 62. Drawn to an exact scale, here reproduced less than one thirtieth actual size of animals. Sketch showing the evolution of the horses from the primitive four-toed ancestor to the last American horse prior to the extinction of the race. This series of drawings has been made on the basis of fossil remains of each of the forms in the Yale collection. The stages in development represented in the drawings are: Fig. 1. *Eohippus,* or Dawn Horse of Lower Eocene time, earliest of native American horses, four toes; Fig. 2. *Orohippus,* the mountain horse of Middle Eocene time, four toes; Fig. 3. *Mesohippus,* of Oligocene time, three toes; Fig. 4. *Merychippus,* of Miocene time, three toes; Fig. 5. *Pliohippus,* of Pliocene time, one toe; Fig. 6. *Equus scotti,* of Pleistocene time, the last of the native American horses, of which a nearly perfect specimen was collected by the Yale expedition of 1912. After Lull.

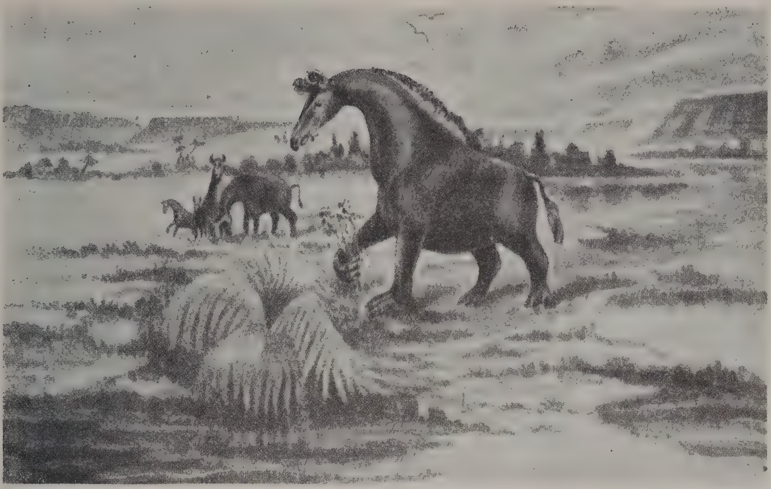

Fig. 63. The curious extinct mammal, *Moropus cooki* Barbour, from the Tertiary deposits of Nebraska, had a body like a tapir, with high shoulders; a neck and head resembling a horse; with three toed feet provided with hoofs so compressed and modified as to resemble claws, and possibly used as such in gathering together boughs of trees and tall grasses, or in tearing roots from the ground. Bones of this creature were found in abundance in a layer of rock near the top of a hill like the one shown in Figure 64. The *Chalicotheroidea* had a short geological history. After Barbour.

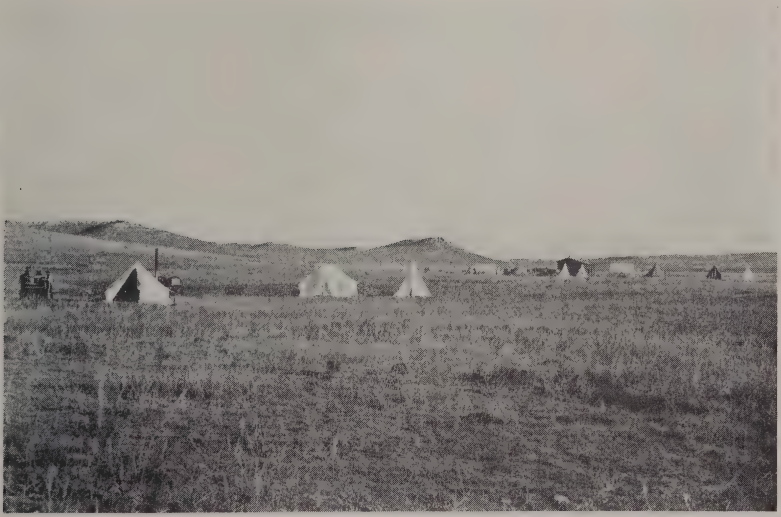

Figure 64. Camp of paleontologists on the high plains of northwestern Nebraska in the summer of 1908, near the Niobrara River, on the Agate Springs Ranch. Fossil-bearing rocks of Miocene age outcrop in the drainage channels and near the tops and along the sides of hills. The three tents to the left belong to the party from the American Museum of Natural History; to the left in the background the party from Amherst College; the University of Nebraska occupied the cabin; Yale University Museum to the extreme right and the Carnegie Museum party camped nearby. This was a notable gathering of a score of paleontologists. Photo by Thompson.

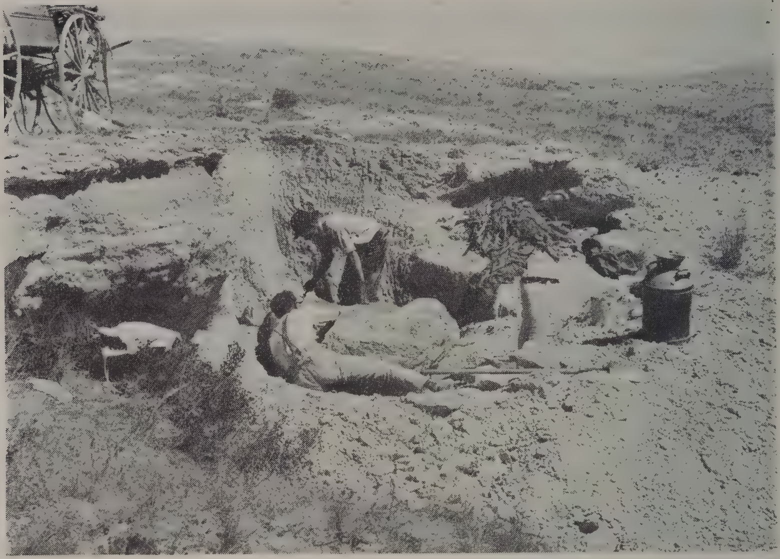

Fig. 65. In the block between the workers are skeletons of five oreodonts, small Miocene ungulates, in the hills in the background of Figure 64. When the block had been sufficiently excavated strips of burlap soaked in wet plaster were used to strengthen the rock so that the block could be turned and so removed to the Museum where the skeletons could be cleared of matrix. Photo by Thompson.

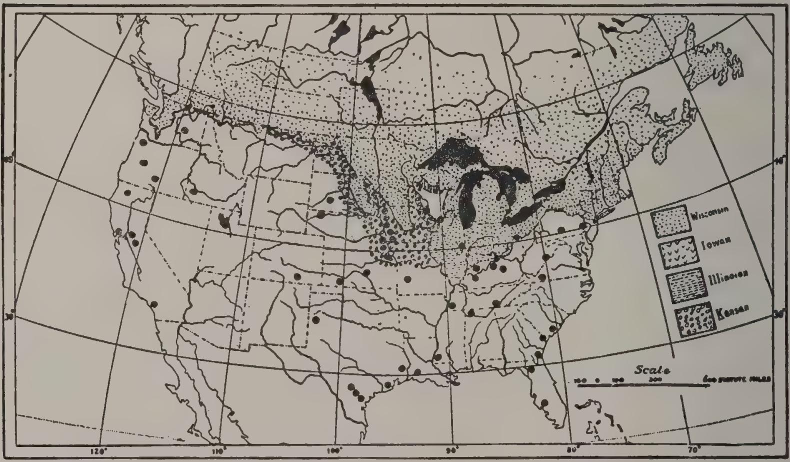

Fig. 66. Distribution of localities where remains of the Pleistocene great ground sloths have been found. There are three chief genera: *Megalonyx*, *Mylodon* and *Nothrotherium*, listed in a descending scale as to size. After Hay.

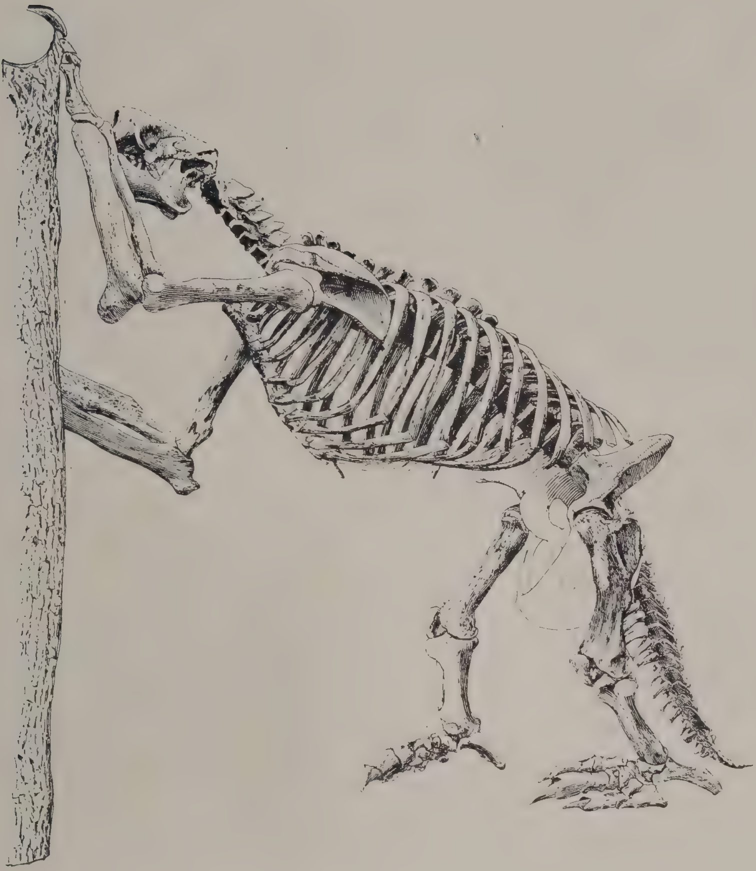

Fig. 67. General view of the left side of the giant Edentate, *Megalonyx jeffersonii,* shown in the attitude of browsing upon tree foliage according to the interpretation of Sir Richard Owen, following his deductions after a study of the skeleton. After Hay.

THE MAMMALS DURING THE GREAT ICE AGE IN INDIANA

The mammals of the Pleistocene of Indiana are very largely extinct, not only in Indiana, but throughout the North American continent. Among those now totally extinct throughout the world may be cited the giant edentates and the giant beaver. The musk-oxen found fossil in Indiana now live farther north. Their occurrence in Indiana indicates a far southern extension of their range during the Ice Age. Horses after living in North America for millions of years became extinct in the continent and were later reinstated after the Caucasian invasion.

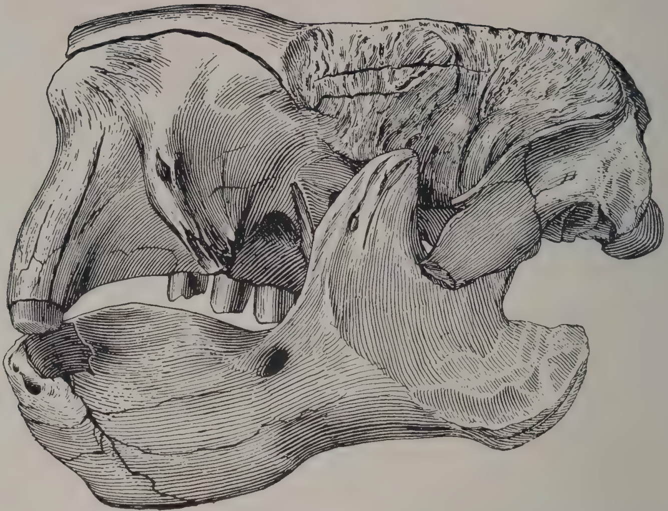

Fig. 68. Left side of skull and jaw of *Megalonyx jeffersonii*, showing its massiveness. The diploic air-spaces were very extensive and served as adequate protection to the brain even after very severe injuries. Owen has described such an injury in great detail. After Hay.

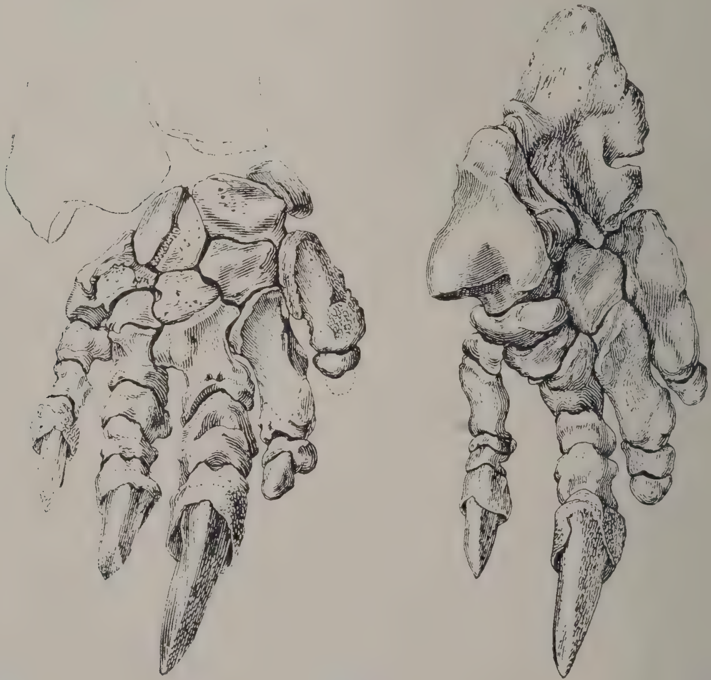

Fig. 69. Front and hind feet of another ground sloth, *Myiodon robustus*, regarded as effective organs for undermining trees to secure the foliage. After Hay.

THE GREAT GROUND SLOTHS

This group of giant mammals, confined exclusively to the western hemisphere, were widely distributed throughout the United States (Figure 66). The general appearance of one genus is shown in the frontispiece. This same species lived in Southern California* and in the eastern states. Several more or less complete skeletons are known from the Rancho la Brea asphalt pits at Los Angeles. Stock's account* based on this material is the best and most complete discussion of the group which has ever appeared. Hay (see Bibliography) has written extensively of the association of these giant edentates with the other Pleistocene species discussed.

Only one species of this group, *Megalonyx jeffersonii* (Figure 67), has been found within the state. This was described by Leidy.

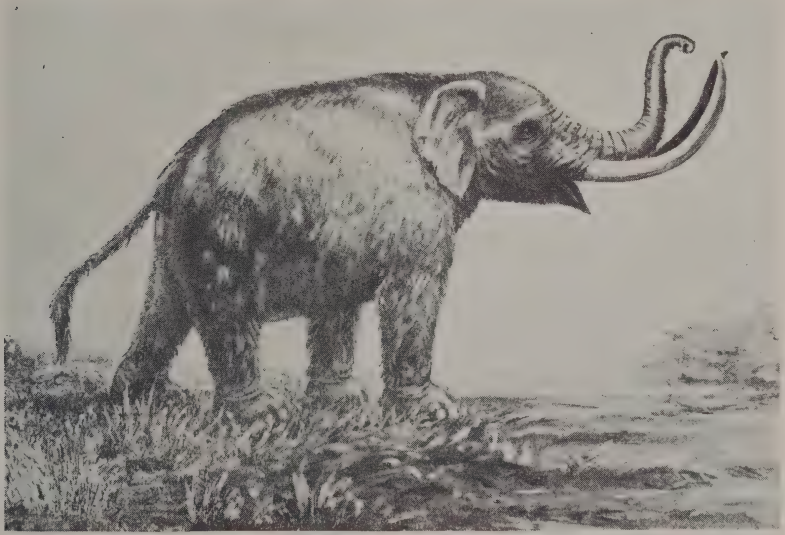

Fig. 70. A restoration of the American mastodon as it probably appeared in life. It has been stated that the body was clothed in rather long, deep-red hair, but there are some reasons to doubt this. After Lucas.

THE MASTODONS

Bones and teeth of the American Mastodon have been found in the unglaciated parts of Indiana as well as within the various accumulations of drift. Hay has recorded over fifty localities where mastodon remains have been found. These proboscideans ranged during the Pleistocene throughout the whole of the United States, British Columbia and

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* Stock, Chester, 1925. Cenozoic Gravigrade Edentates of western North America, with special reference to the Pleistocene Megalonychinae and Mylodontidae of Rancho la Brea. Publication 331, Carnegie Institution of Washington, pp. 1-206, 117 figures, plates 1-47.

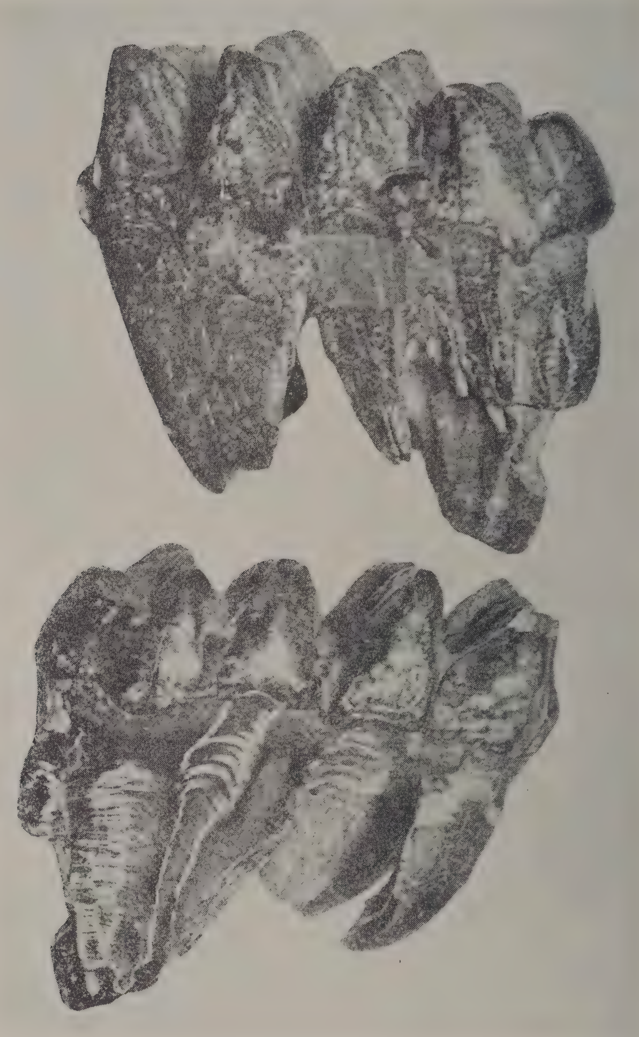

Fig. 71. The teeth of the American mastodon have high, sharply-defined transverse ridges, in sharp contrast to those of the mammoth (Figure 76). After Lucas.

Yukon Territory. The size was about the same as that of the living elephant. Traces of the skeletal parts of the animal exist throughout the many thousands of years during which the Pleistocene existed.

A complete skeleton of the American Mastodon, found in Miami County, Indiana, is mounted (Figure 72) in the Public Museum at Milwaukee. Another, slightly damaged by fire, is in the Joseph Moore Museum at Earlham College.

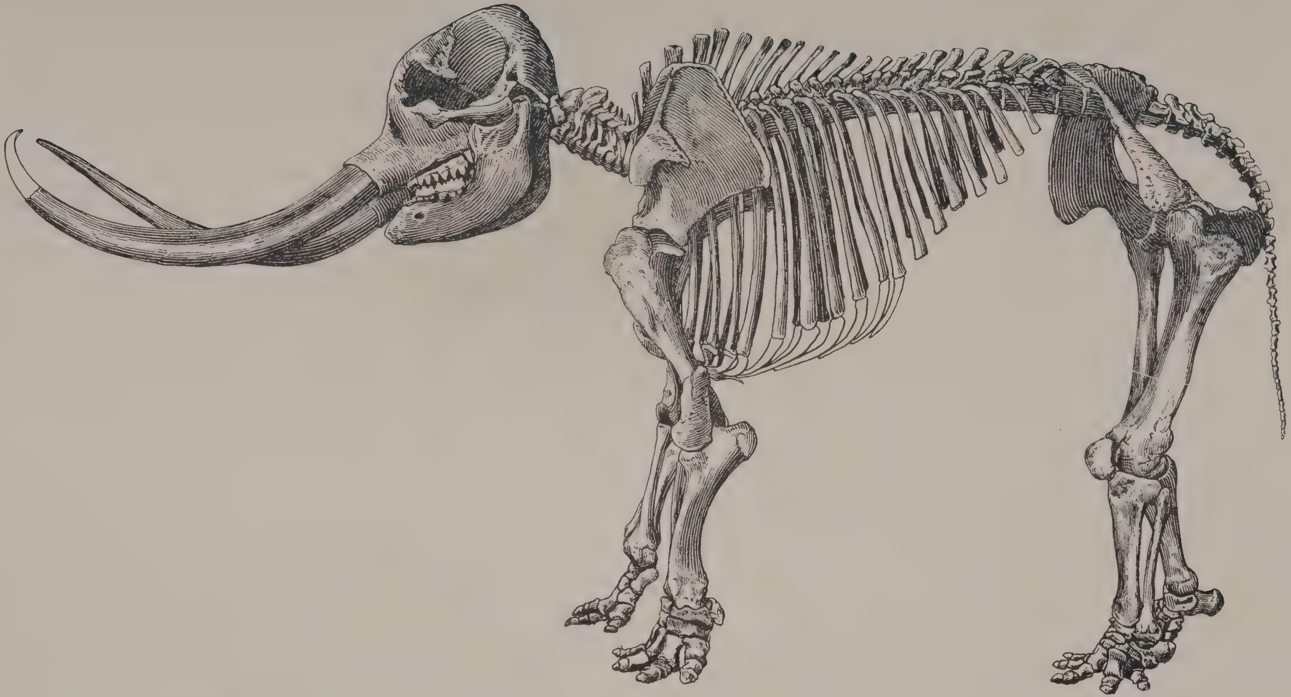

Fig. 72. *Mammut americanum.* Skeleton of a specimen found in Miami County, Indiana. Now in Public Museum, Milwaukee.

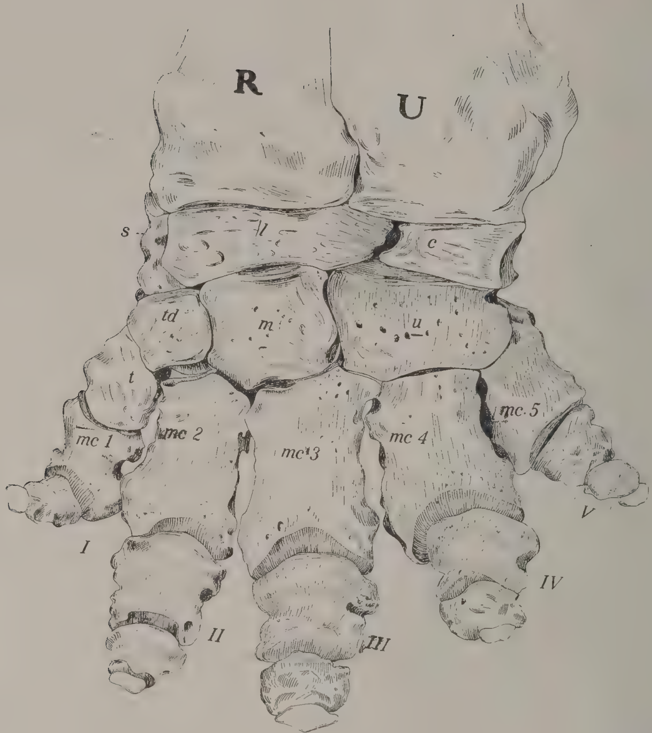

Fig. 73. *Mammut americanum.* Left fore foot seen from in front. R, radius; U, ulna; I, inner digit; V, outer digit; c, cuneiform bone; l, lunar; s, scaphoid; td, trapezoid; m, magnum; u, unciform; mc 1 to mc 5, the metacarpals.

The character of the teeth will immediately distinguish the mastodon from other proboscideans, the enamel plates being drawn up into sharp crests (Figure 71). The animal may have as many as twenty-four of these teeth from birth to old age, the teeth being discarded as rapidly as they cease to function in mastication. It is not possible, in all cases, to distinguish the mastodon by its tusks alone. In general the tusks are straighter than those of the mammoths.

The unsatisfactory evidences of the nature of the food of the Pleistocene mastodons indicates that twigs and foliage of conifers and other trees, the succulent flowering plants and certain mosses formed the diet of the Pleistocene mastodons, very much as the elephants of today. It is possible that the Pleistocene mastodons chewed up fairly large boughs and after extracting the juices spit out the woody pulp, as modern elephants are said to do.

FOSSIL ELEPHANTS

The best known species of all the fossil elephants is the hairy mammoth, *Elephas primigenius,* of which there have been about a dozen finds in Indiana. Its range was enormous, greater than that of any

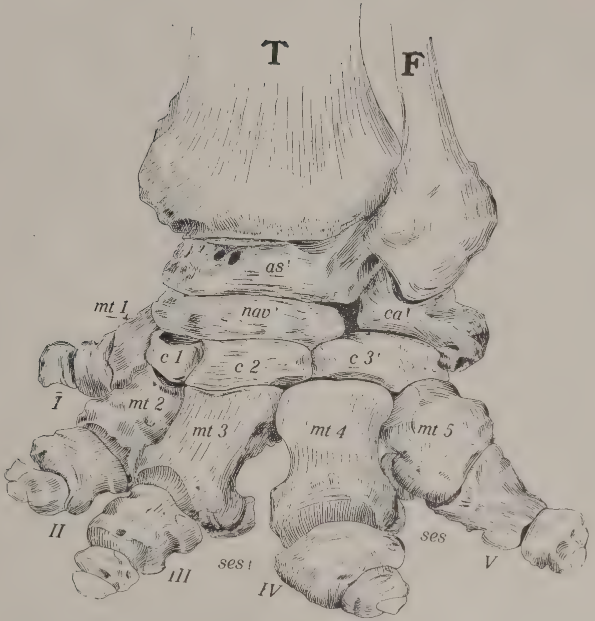

Fig. 74. *Mammut americanum.* Left hind foot, seen from in front. After Warren. *T,* the tibia; *F,* the fibula; *I,* inner digit; *V,* the outer digit; *mt 1* to *mt 5,* the metatarsals; *as,* astragalus; *ca,* calcaneum; *nav,* navicular; *cu,* cuboid; *c1, c2, c3,* the internal, middle, and external cuneiform bones; *ses,* sesamoids.

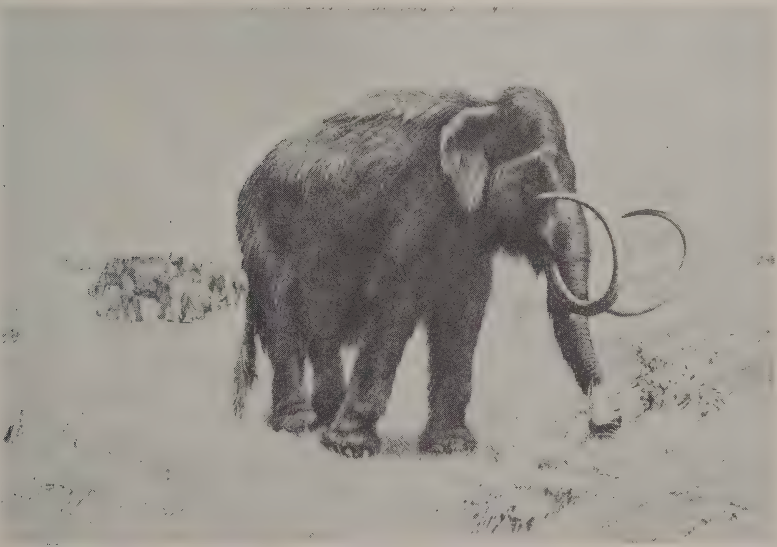

Fig. 75. A restoration of the hairy mammoth, *Elephas primigenius,* as it probably appeared in life. This species had an extremely wide range. This is the animal whose cadavers have been frozen in the Siberian marshes. After Lucas.

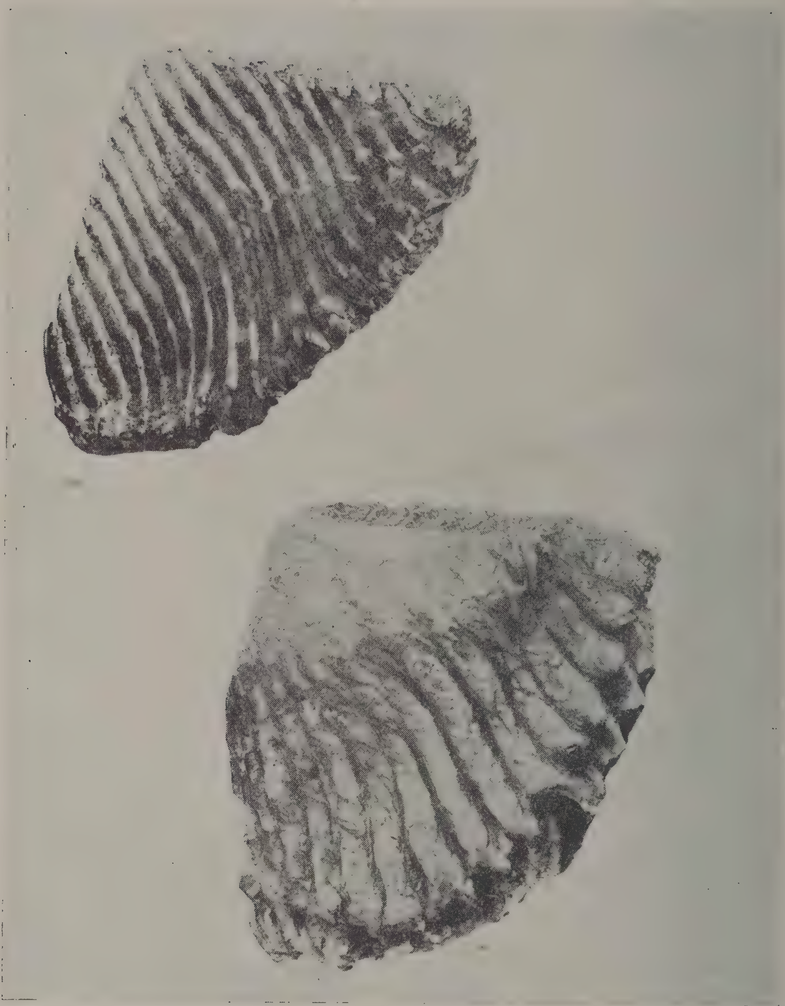

Fig. 76. The teeth of the mammoth are flat-crowned (compare with the Mastodon teeth, Figure 71). After Lucas.

other mammal that has not been distributed by man. Its skeletons and teeth have been found in Ireland and England, across the continent of Europe and Asia to Bering Strait, and from Alaska to the Atlantic Ocean and south over the glaciated regions to North Carolina. While its remains are abundant it is still infrequent when compared with the mastodon.

One of the most interesting discoveries in paleontology was the finding of the frozen cadaver of a hairy mammoth in 1901 on the banks of the Beresowka River, in eastern Siberia. The body was sufficiently well preserved for dissection. Three kinds of hair were found on the body, wool, hair and bristles, of a yellowish brown color. The tusk in one specimen had a length of over thirteen feet. The stomach of the Beresowka mammoth was filled with recently eaten food, composed of species of plants occupying that region today, indicating that the climate has not changed. Portions of cadavers have been found in Alaska, but the Indiana finds have all been bones and teeth.

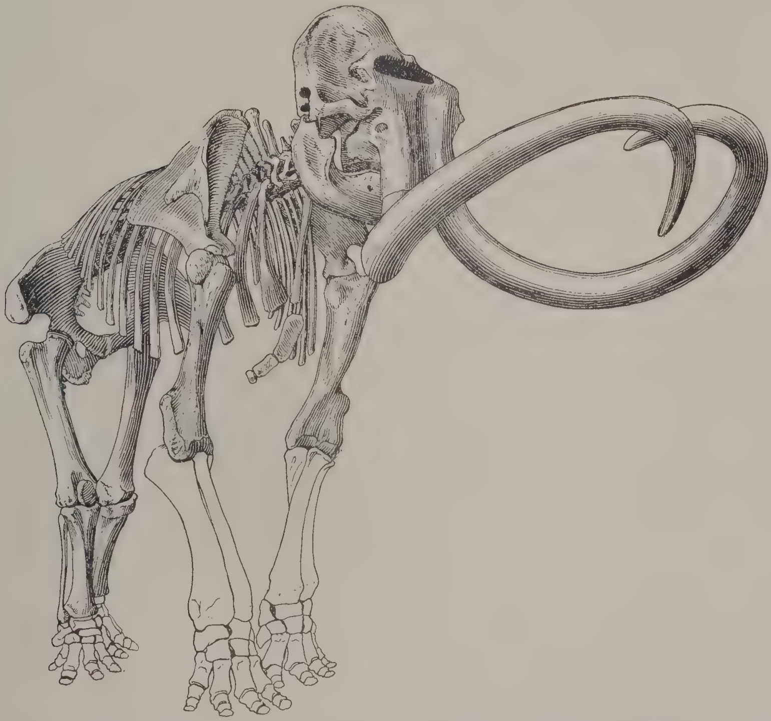

Fig. 77. Skeleton of the hairy mammoth, *Elephas primigenius*, found in Grant County, Indiana, and mounted in the American Museum of Natural History. After Hay.

Another species of mammoth, *Elephas columbi*, occurs as abundantly in the Pleistocene deposits as does the hairy mammoth, from which it is entirely distinct.

Many discoveries of skeletal remains of Pleistocene elephantids in Indiana cannot be identified for one reason or another. They indicate the relative abundance of these proboscideans within the state during the Pleistocene.

TRACES OF ANCIENT HORSES AND TAPIRS

Ancient and possibly extinct species of horses once ranged over Indiana, but traces of them are very rare. A neck joint found at Evansville possibly represents the species *Equus complicatus*. The bone was found associated with remains of extinct Pleistocene mammals such as the dire wolf, an edentate, a bison, a tapir and a deer. It is well known that the Equidae, or horse family, had their origin and went through an extensive development in America, over a period of millions of years (Figure 62), from the Eocene to the Pleistocene, only to become totally extinct and to have spread again over the entire area (Figure 78) after the coming of Europeans in the sixteenth century.

A single tooth represents the presence in Indiana of the extinct species of tapir, *Tapirus haysii*. Other modern species of the Tapiridae inhabit tropical America and tropical Asia. Fossil tapirs, however, occur in Europe and in North America.

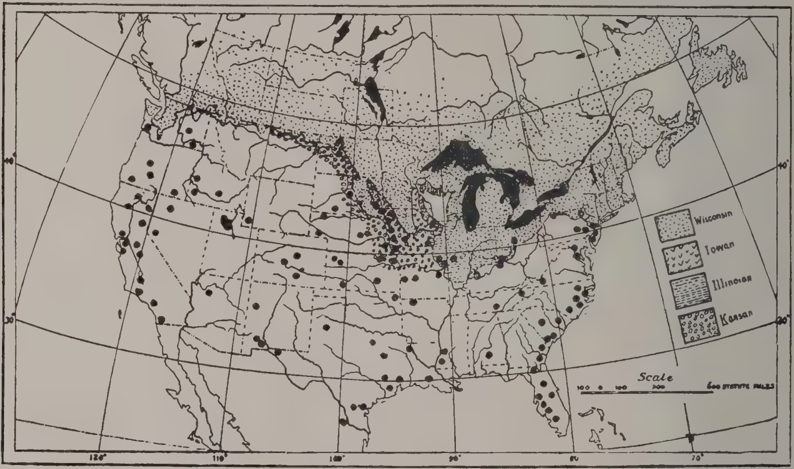

Fig. 78. Map showing localities where remains of fossil horses have been found in the United States and the relations of these localities to the various drift-sheets. After Hay.

PLEISTOCENE PECCARIES

The superfamily *Suoidea* contains the true pigs and the peccaries. Hogs are unknown from the Pleistocene, but remains of their relatives, the peccaries of the family Tayassuidae, are fairly abundant. Remains found in well-digging at a depth of 30 to 40 feet have been described from Indiana and Kansas, while other finds have been recorded from

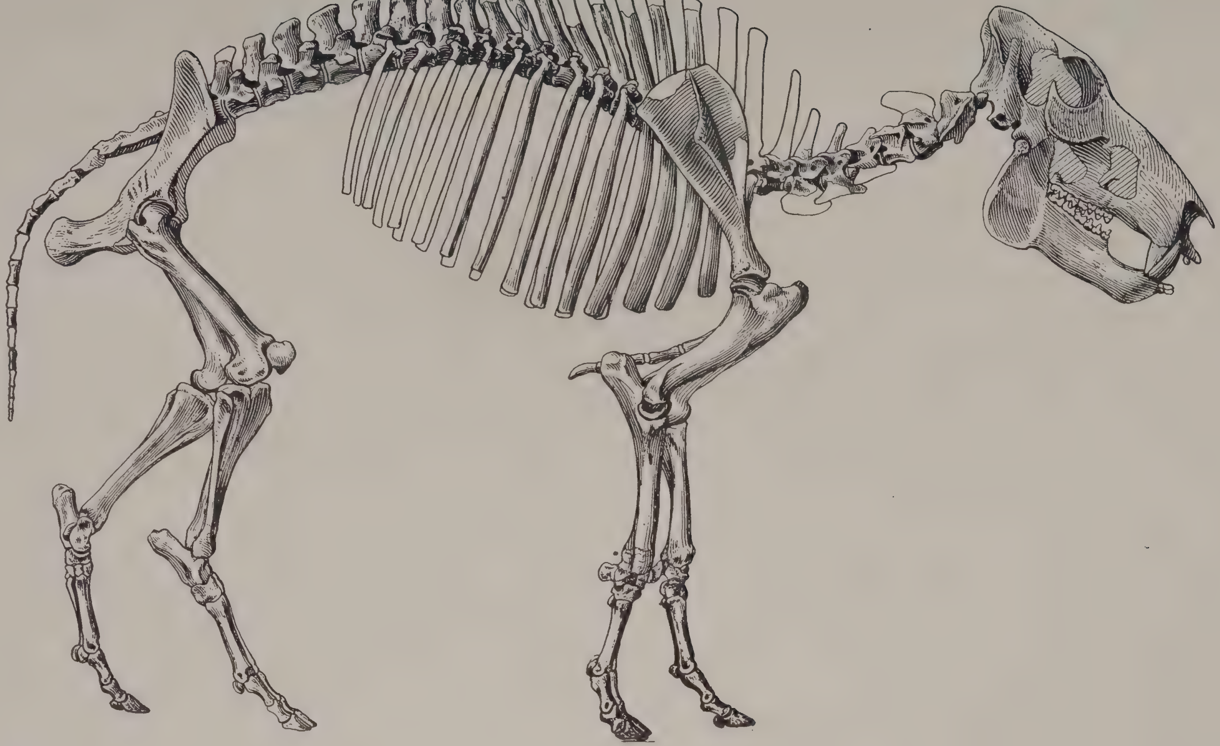

Fig. 79. A skeleton of the Pleistocene peccary, found in Kansas, as mounted in the American Museum of Natural History. *Platygonus leptorhinus.* After Hay.

fissures and caves. The fossil species are, in general, larger than the living peccaries found in southern United States south to Patagonia. Eighteen complete individuals were excavated in Ohio at a depth of 12 feet, in two groups, with noses all pointing the same way. The peccaries probably piled up to avoid the cold, as does the domestic pig, and were buried in a blizzard, or the caving in of the river bank. Similar conditions were found in the Kansas locality (Figure 79). A full account of this group as it occurs in Indiana is given, with abundant illustrations, in Hay's report (1912) on the Pleistocene vertebrates of the state.

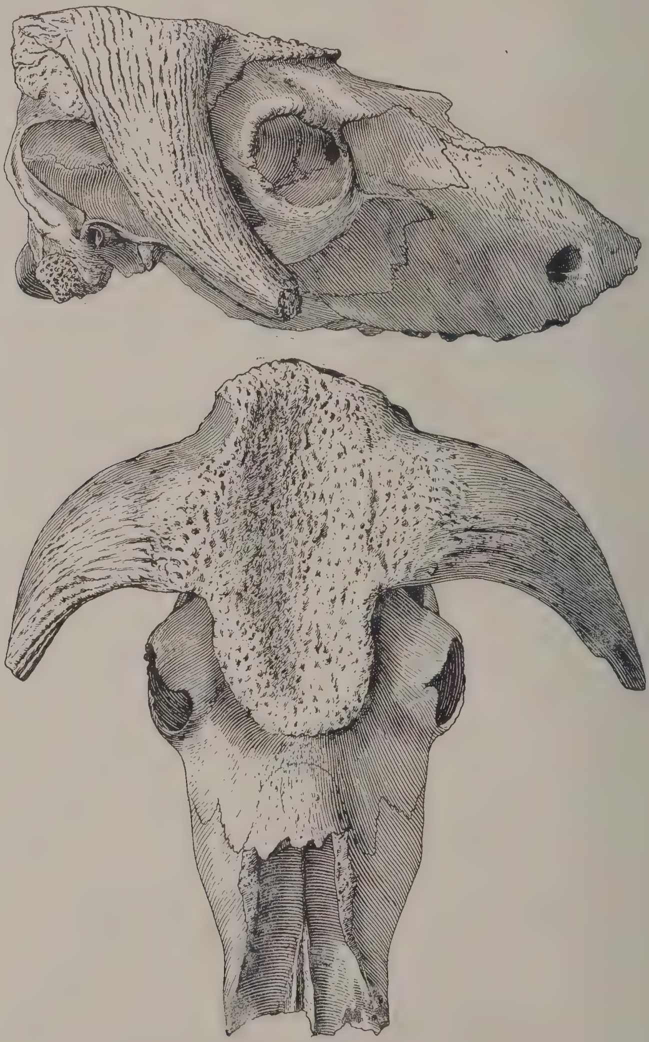

Fig. 80. Side and front views of the fossil musk-ox, *Symbos cavifrons*, skull found at Hebron, Indiana, and now preserved in the American Museum of Natural History. About 1/6 nat. size. After Hay.

THE DEER FAMILY

The existence of members of the deer family, Cervidae, in Pleistocene deposits of Indiana indicates an antiquity for the Virginia deer, the elk, and possibly other species, which is interesting since it shows that the area has been congenial for the deer for many thousands of years. It is possible that the moose and the caribou ranged down into Indiana during the Ice Age but positive remains have not been identified. The confusion resulting from the difficulty of being sure of the exact age of the material, whether Pleistocene or Recent, renders the matter of the Pleistocene Cervidae unsatisfactory.

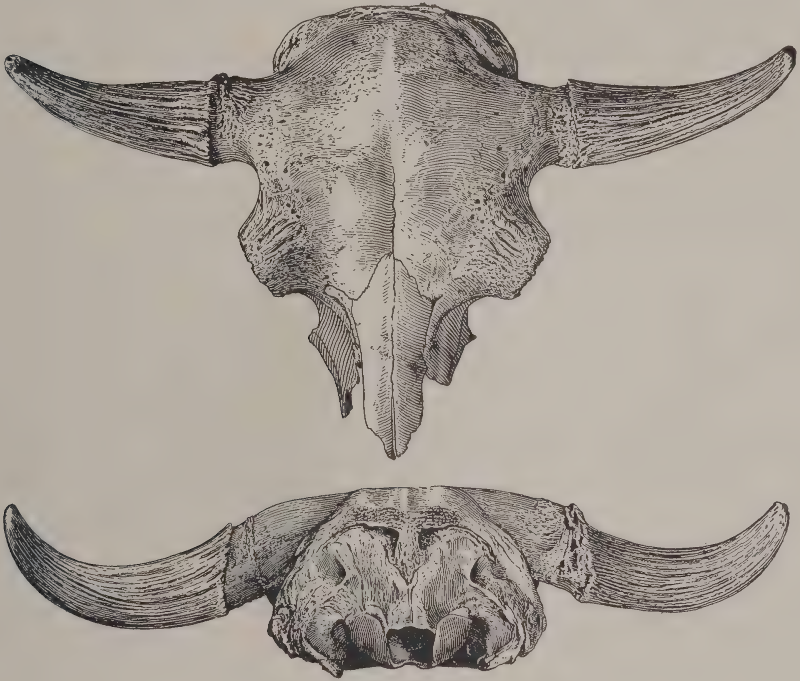

Fig. 81. Front and back views of the fossil skull of *Bison antiquus*, found at Vincennes, Indiana. After Hay.

MUSK-OXEN AND BISONS

The occurrence of the musk-ox, *Symbos cavifrons*, within the Pleistocene deposits of Indiana (Figure 80) is not at all surprising since it merely means that these creatures extended their present range southward during the extreme cold of the Ice Age. Specimens found within the state are preserved at Earlham College and the American Museum of Natural History.

Fossil bisons, of an extinct species, have been found within the state (Figure 81), but these animals had their chief habitat to the westward, and remains found in the eastern limits of their range are rare.

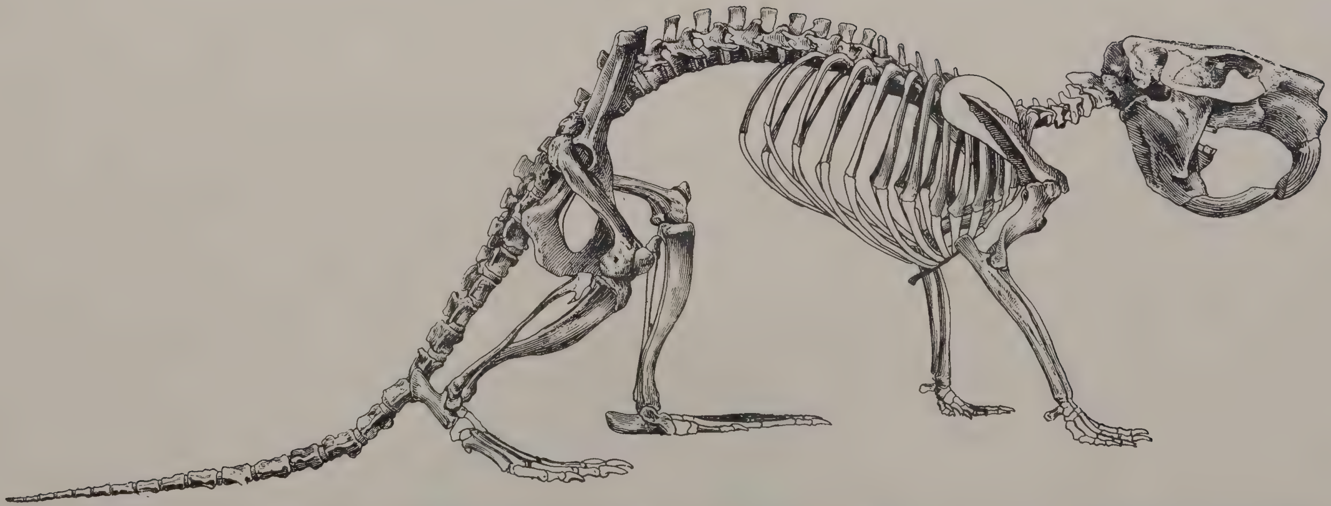

Fig. 82. The most complete skeleton of the giant beaver, *Castoroides ohioensis*, as mounted in the Joseph Moore Museum of Earlham College at Richmond. The length of this youthful individual is seven feet two inches. The remains were found in a swamp near Winchester. The skeleton was described and figured by Joseph Moore in the American Geologist, XII, 68-74, pl. xii, and in the Journal of the Cincinnati Society of Natural History, XIII, 138-169, 25 figs. It is further described by Hay in his Indiana report, 1912, pp. 755-768. After Hay.

THE GIANT BEAVER

The chief paleontological treasure of the Joseph Moore Museum of Earlham College, Richmond, is the mounted skeleton of the giant beaver, *Castoroides ohioensis*, first described from Ohio in 1838, found in excavating a canal. The skeleton referred to above was found in Dismal Swamp, Randolph County, Indiana. The giant beaver, attaining a maximum length of nine feet (Figure 82), belonged to the earlier phases of the Pleistocene and existed long after the disappearance of the ice. Numerous specimens have been found ranging from New York to the Great Plains and from Florida to Minnesota, as well as in Yukon Territory, nearly up to the Arctic Ocean. About a dozen finds of the giant beaver have been made in Indiana. The habits of the animal can only be conjectured from its skeleton, and this indicates habits similar to the modern beaver, which has a similar geological history, occurring in early Pleistocene deposits.

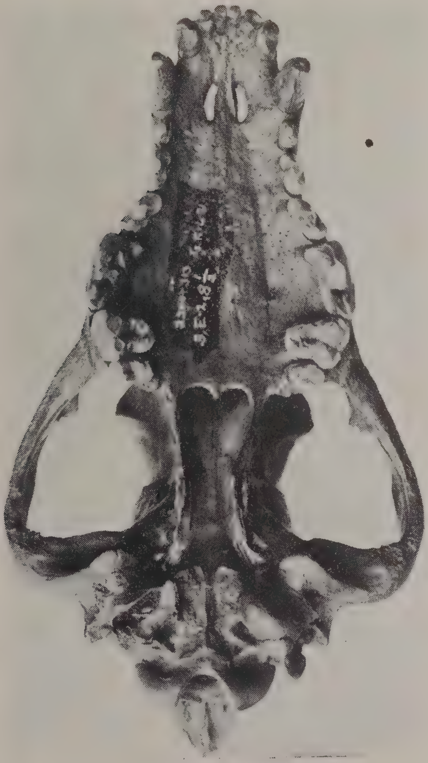

Fig. 83. The palate, showing full upper dentition, of a skull of the dire wolf, *Aenocyon dirus*, from the asphalt of Rancho la Brea at Los Angeles. Mature individual. *Courtesy of the Los Angeles Museum.*

THE DIRE WOLF

The type material for the species *Aenocyon (Canis) dirus*, the giant wolf of the Pleistocene (Figures 83, 84), based on incomplete parts was found in Indiana. The species is now very thoroughly known because of the abundant skeletal remains secured within recent years from the asphalt deposits at the Rancho la Brea. The Los Angeles Museum possesses more than 1,200 specimens—enough to prepare several hundred complete skeletons. The photographs (Figures 83, 84) are of a singularly complete skull and jaw in that Museum. In Indiana remains of this great wolf are associated with other extinct mammals.

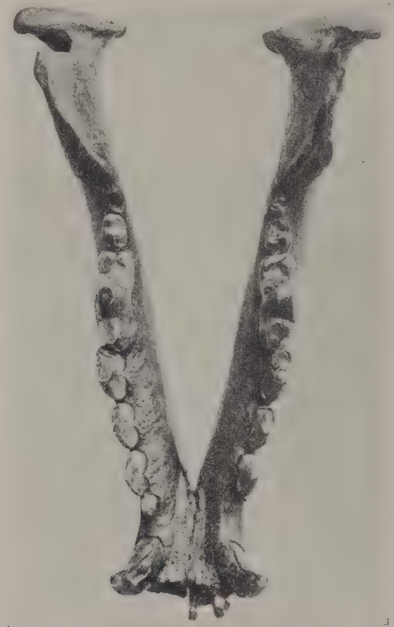

Fig. 84. Crown view of the inferior dentition of the dire wolf, complete with the exception of the last right molar, and the incisors which had been loosened by pyorrhea. The jaw definitely belongs to the skull, an unusual occurrence since skeletal parts are usually separated in the asphalt. The evidences of pyorrhea are discussed in the "Annals of Medical History, X:199-201, 3 figs., 1928." *Courtesy of the Los Angeles Museum.*

A FOSSIL BEAR

An incomplete skull found in digging a well in Ohio seems to indicate the presence of an extinct bear, *Ursus procerus* Miller, found in glacial deposits. This species is the only bear known from the Pleistocene of the region about Indiana, except the *Ursus americanus*. The bear family is widely distributed, but none is known in America before the beginning of the Pleistocene. It will be of interest to note here the nature of the short-faced bear, *Arctotherium*, in California.* This paper contains an interesting discussion of the Pleistocene Ursidae and carries an extensive literature list.

TYPES OF PRIMITIVE MAN

Since the history of ancient human existence in Indiana and in the Western Hemisphere as a whole, totalling at the most only a few thousand years, is so brief, we must turn to the Old World for evidences of early man and the fossils of all the higher anthropoids (Gregory & Hellman, '26). It has long been thought that man originated near central Asia (Gregory, '27 a) and from that point spread abroad over the earth. Compared with other mammals[*] man has shown an extreme degree of adaptation, so far as habitat is concerned. Groups of man now occupy every region on the globe, from the coldest to the hottest. High and low he has sought out and adopted many places where he might survive. There is no accepted paleontological evidence to show that man arose from the monkeys (Gregory, '27) or even from any known apes, but it seems certain that all the anthropoids, including both man and all the apes, had a common, but still unknown, ancestor (Figure 85) far back in geological time. This is one of the most interesting and important phases of research today, and all the evidences are being closely scrutinized.

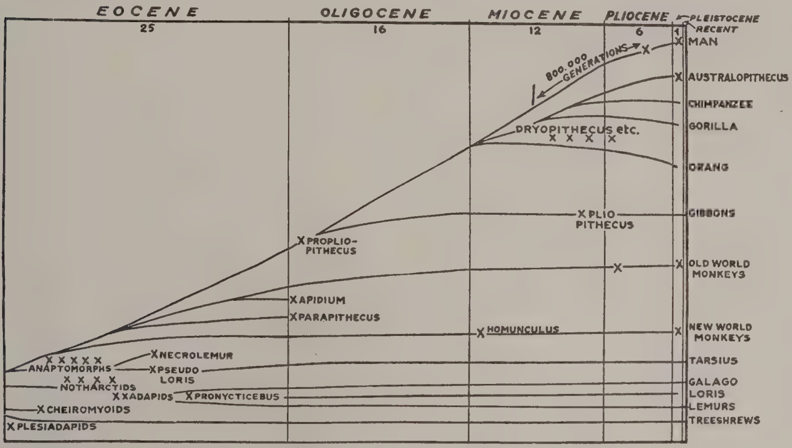

Fig. 85. Tentative Phylogeny of the Primates. After Gregory.

Many years ago a surgeon in the Dutch army, then stationed at Java, discovered in a bed of river wash, from which Pleistocene mammal bones had been secured, the skull cap, limb bones and teeth of what is undoubtedly the oldest man-like form (Figures 86-88) for which the name *Pithecanthropus erectus* was proposed. These fossil bones have become extremely famous, in spite of the fact that the discoverer after publishing his memoir on them, refused for forty years to let anyone

---

[*] Merriam, J. C., and Stock, Chester, 1925. Relationships and Structure of the short-faced bear, Arctotherium, from the Pleistocene of California. Publ. 347, Carnegie Inst., Wash., pp. 1-35, 10 plates and five figures.

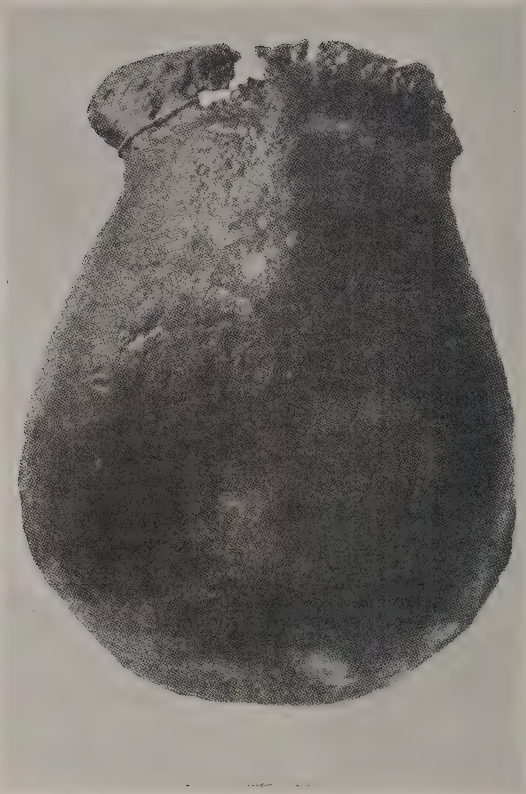

Fig. 86. Upper aspect of the skull cap of the oldest man-like form, *Pithecanthropus erectus* Dubois, from the river drift, Upper Pliocene or Lower Pleistocene, of Java; 500,000 years old. From Hrdlicka.

have access to the specimens in Haarlem, an attitude which he has recently abandoned. *Pithecanthropus* is an extinct genus of the family Hominidae, and it is the most primitive man-like species known.

More recently in England, in ancient river deposits, remains of another extinct genus of the Hominidae known as *Eoanthropus*—the dawn man—has been discovered (Figure 91). The skeletal parts are quite incomplete (see Hrdlicka, '14; MacCurdy, '24) and some aspects of the reconstruction are questioned, but it is generally accepted that this fossil genus is intermediate in structure between *Pithecanthropus* and *Homo*. An age of several hundred thousand years may be assigned to the Dawn Man.

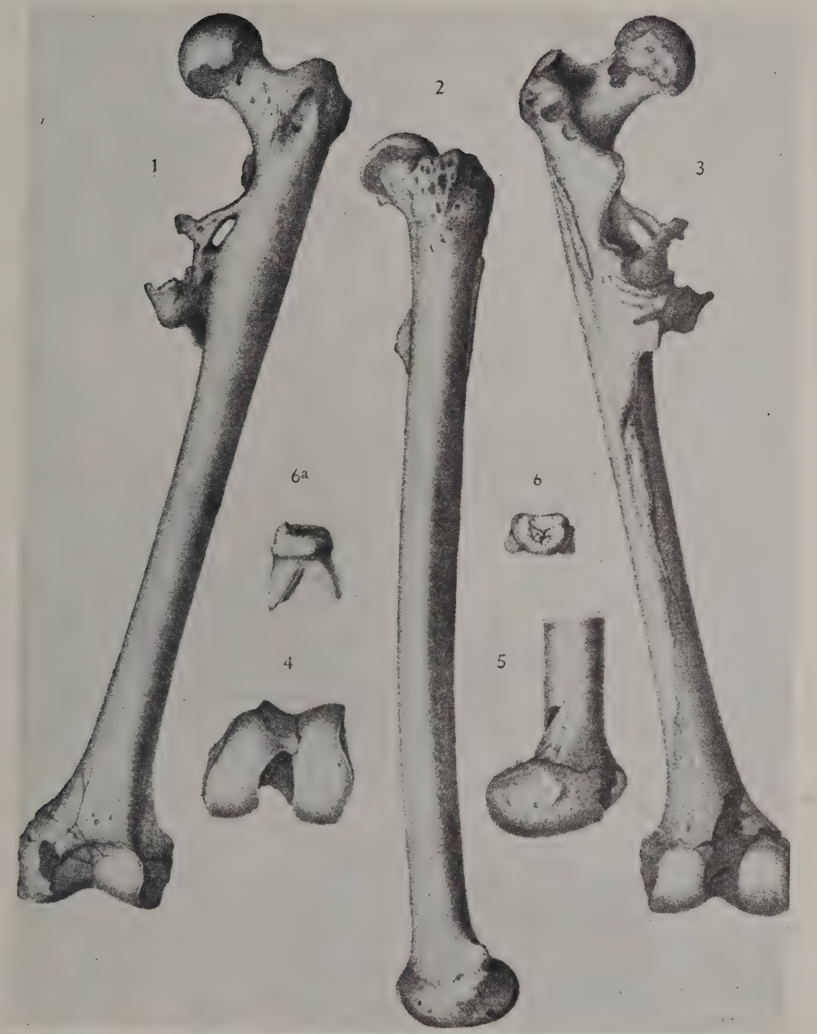

Fig. 87. *Pithecanthropus erectus.* Left femur: 1, from before; 2, from side; 3, from behind; 4, from below; 5, lower end from median side; 6, right third upper molar, from below; 6a, from behind. After Dubois.

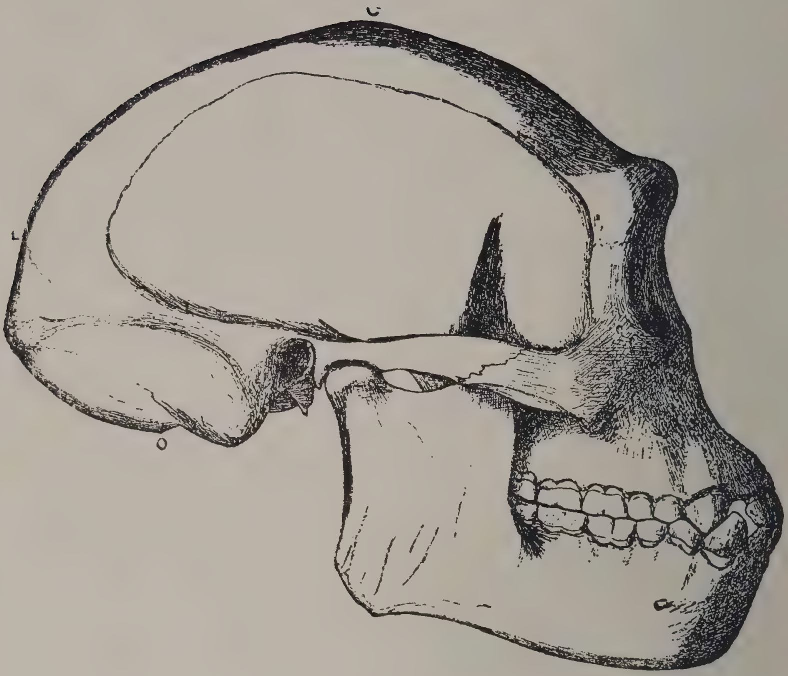

Fig. 88. Restoration of the skull of *Pithecanthropus erectus.* Half the natural size. After Dubois.

Other earlier and later discoveries in western Europe have revealed, chiefly in cave deposits (Figure 89), the presence of several extinct species of the genus *Homo* to which modern man belongs (Figures 93-94). The species lived during the Paleolithic or Old Stone Age (Osborn, '15) and were acquainted with the Pleistocene cave-bear, the sabre-tooth, the mammoth, the woolly rhinoceros and the horse. These Paleolithic people left abundant evidences of their artistic abilities by paintings on the walls and roofs of the caverns they inhabited. Sculpture in clay was a part of their record, and these histories have been preserved over many thousands of years in caves whose inhabitants have perished in the long ago.

One of the most important and abundant records left by early man was his work in flint (MacCurdy, '24), either as tools or as weapons. The term *eolith* designates a crudely chipped flint which played a part in human history. Such flints are found in rocks of Tertiary age, and there is considerable doubt of these flints being hand-made. They were more probably made by frost or mechanical abrasion by erosion. Early man did, however, learn to make beautiful flints.

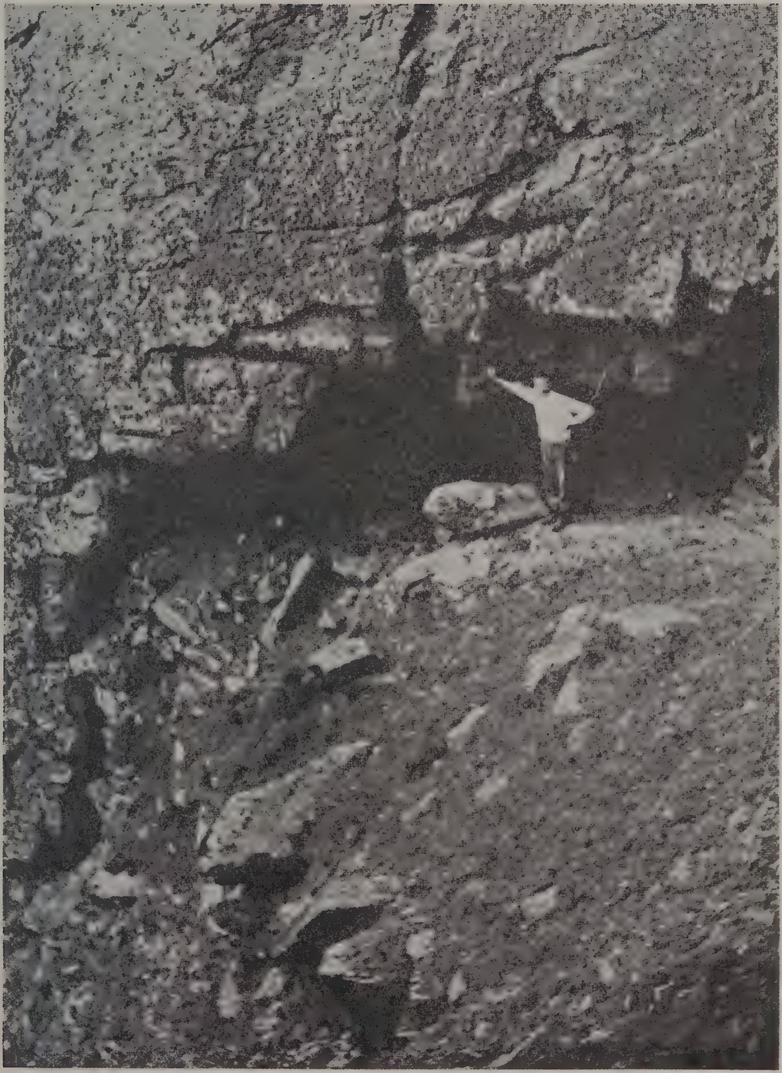

Fig. 89. Early man was long a cave dweller, when possible, and in the floor of this cave in southern England were found many evidences of a long residence by ancient man. Although there are many caves in Indiana, yet none has revealed evidences of man's presence at a period of more than 5,000 years ago. From Hrdlicka.

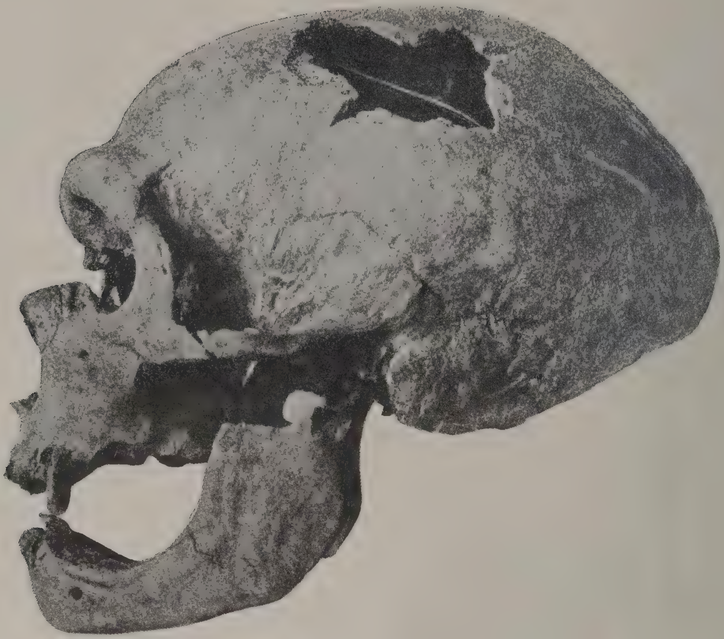

Fig. 90. The La Chapelle-aux-Saints Skull. Side View. This skull was found in a burial, in the floor of a cave in France, and is thought to represent a very ancient race, possibly more than 100,000 years old. It is interesting to note that even in this early time the man had lost most of his teeth from pyorrhea. After Boule.

Gradually the Paleolithic, or Old Stone Age, died out and was replaced by the Neolithic, or New Stone Age, during which men perfected their tools and weapons, and built substantial houses, often for protection, as lake-dwellings. Men learned to till the soil and raise grain, to weave cloth and to make potteries. Yet always ancient man had to do battle with savage beasts, with equally savage men, with disease, with changing environments. It may have been during the closing centuries of the Neolithic that man aspired to erect huge stone monuments, "menhirs," weighing many tons, and to erect huge burial mounds, called "tumuli."

The use of stone tools was unsatisfactory to the humans following the Neolithic age. Stone implements were hard to make. It was difficult to sharpen them to a keen edge. They were heavy and broke easily, and thus was ushered in the Age of Bronze to be more quickly followed by the Iron Age.

It was possibly during the Neolithic that the crowding of populations brought about the impulse to wander, to migrate, to seek out new countries. Possibly some of these ancient races came to America and developed into the American Indian.

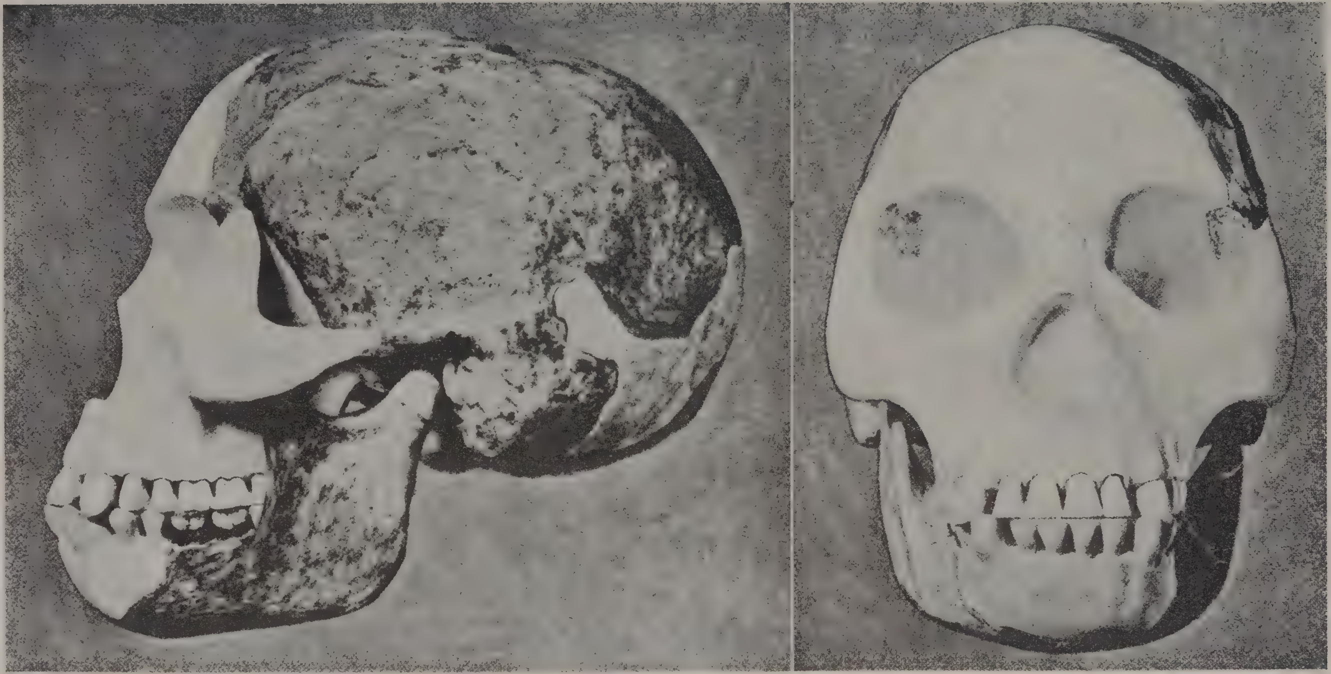

Fig. 91. First restoration of the Skull and Mandible of *Eoanthropus dawsoni.* After Dawson and Woodward.

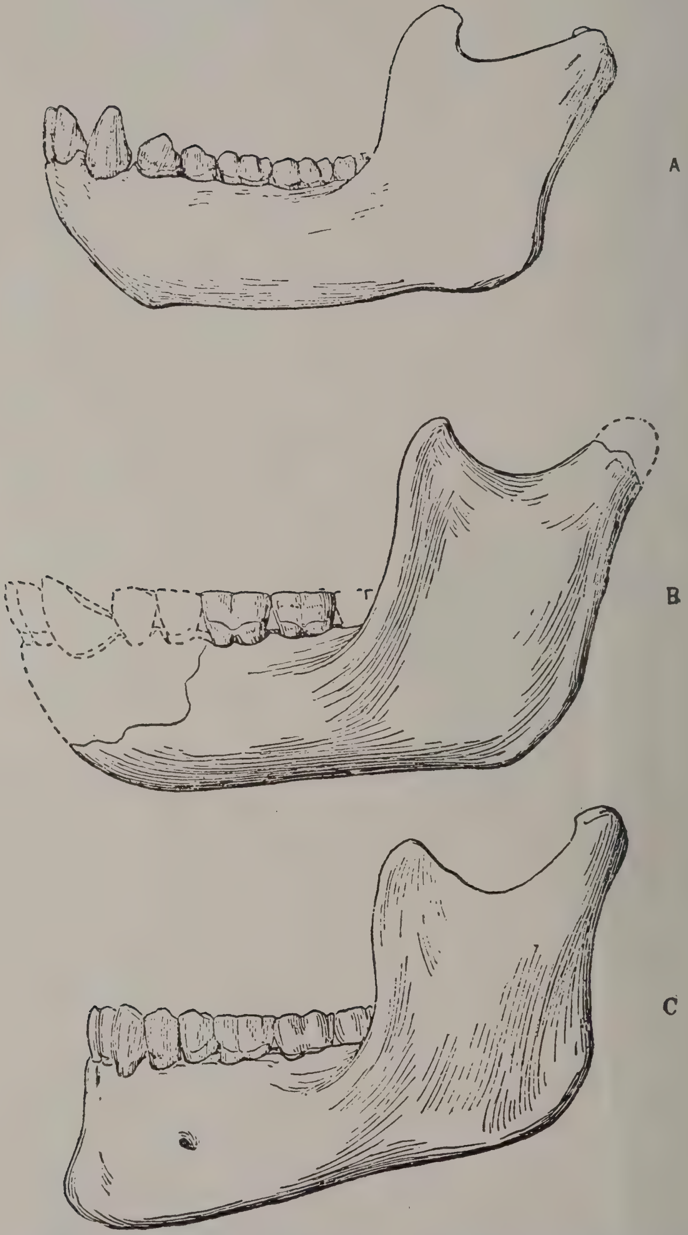

Fig. 92. Restoration of the Piltdown Mandible (B), compared with that of man (C) and young Chimpanzee (A), in left side view. After A. Smith Woodward.

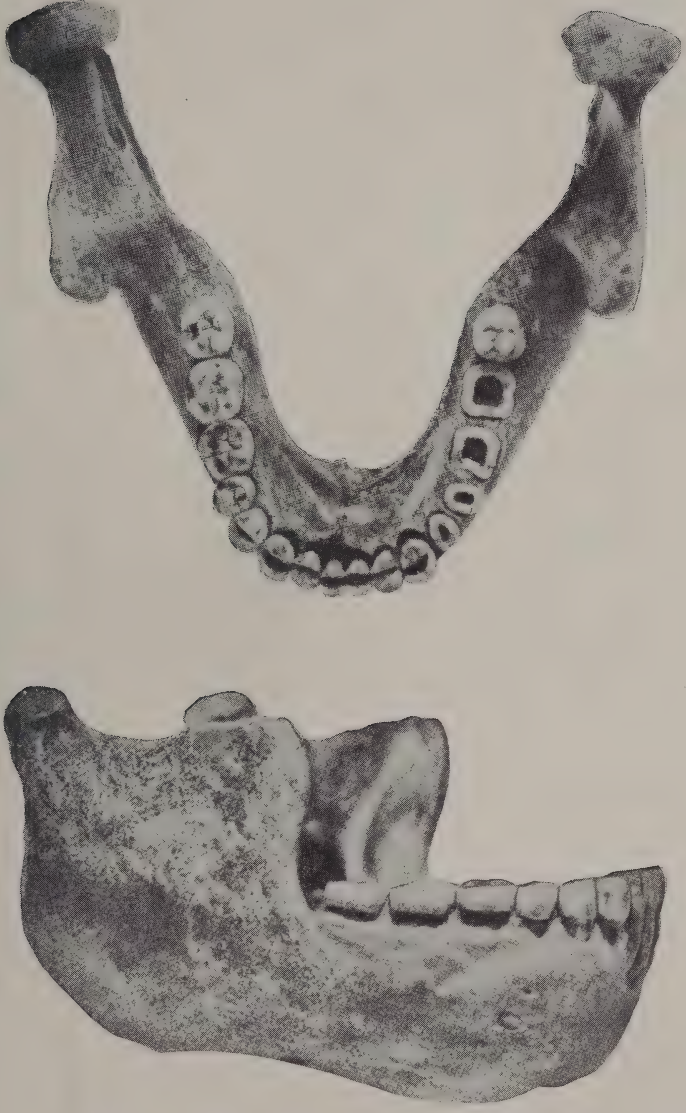

Fig. 93. The Mauer Lower Jaw. After Schoetensack. About two-thirds natural size.

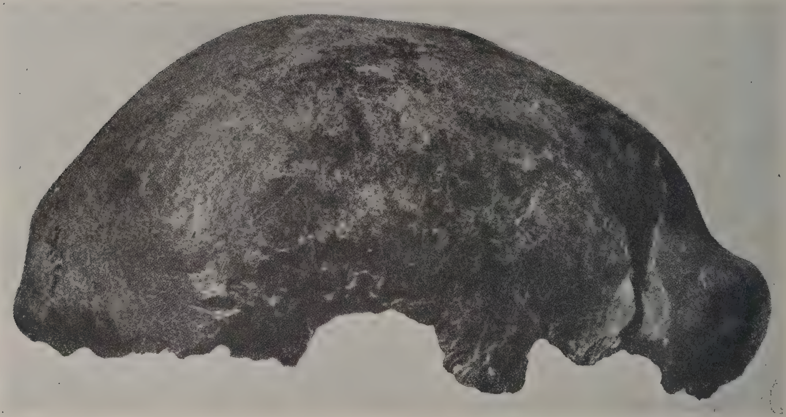

Fig. 94. The Neanderthal Skull. Side view. After Hrdlicka.

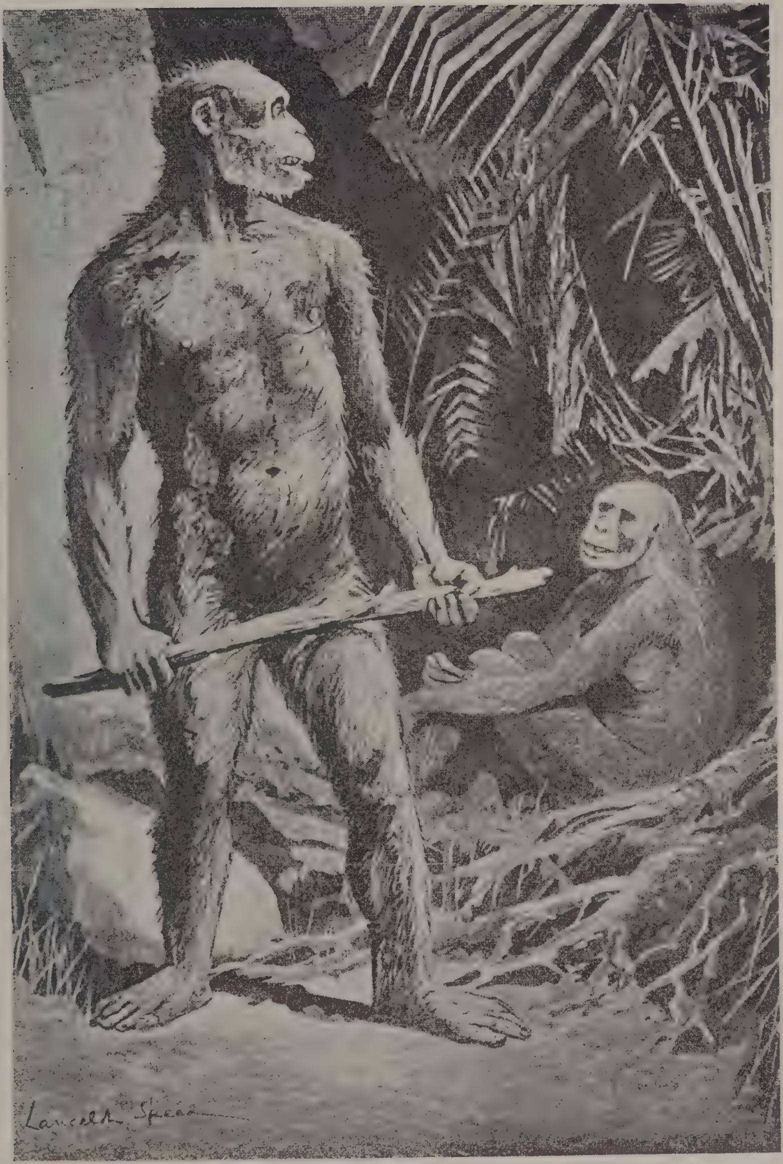

Fig. 95. Restoration of *Pithecanthropus* by L. Speed, from Knipe's *Nebula to Man.*

EARLY MAN IN INDIANA

It is well established that the human race has dwelt in the North American continent for a long time, probably for many thousand years. It seems probable that man entered the continent across the Siberian sea, passing from island to island over a long period of time, and then having attained the continent passed down along the Pacific Coast, and eastward across the plains areas into the eastern forests, thus reaching Indiana relatively late in history. It is not definitely known that man lived in America before the extinction of such Pleistocene mammals as the Mastodon (see papers by Balcom, Gorby and Taylor in Bibliography). MacCurdy* has reviewed the world-wide evidences for the origin of man, and Hrdlicka† has discussed the evidences for North America. More recently a number of writers, Gidley, Hay, Brown, Cook and others, have discussed the association of the remains of early man with the remains of Pleistocene mammals, but none of this bears directly on Indiana, so we may leave the discussion for future investigations.

The number of publications on the nature of primitive man and his evidences is enormous, and many pages could be filled with a list of papers, memoirs, books and reports, in many languages, describing the discoveries relating to early man. The following brief list will serve as a guide to those who desire to read further in this phase of Paleoanthropology.

Gregory, W. K.

1926. Palaeontology of the Human Dentition. The Structural Stages in the Evolution of the Cheek Teeth. Amer. J. Phys. Anthrop., IX: No. 4, 401-426.

This phase of early man is more elaboratory dealt with in Professor Gregory's: "The Origin and Evolution of the Human Dentition," Baltimore, 1922.

1927. How near is the Relationship of Man to the Chimpanzee-Gorilla Stock? Quart. Rev. Biology, II, No. 4, 549-560. Illus.

1927 a. Did Man originate in central Asia? Sci. Monthly, xxiv: 385-401, illus.

1927 b. The Origin of Man from the anthropoid Stem—when and where? Proc. Amer. Philos. Soc., LXVI: 439-463.

1928. Were the Ancestors of Man primitive Brachiators? Proc. Amer. Philos. Soc., LXVII: 129-150, illus.

——— and Hellman, Milo. 1926. The Dentition of Dryopithecus and the origin of Man. Anthrop. Papers of the Amer. Mus. Natl. Hist., XXVIII, part 1: 1-123; plates I-XXV; Figures 1-32; bibliography.

Hrdlicka, Ales. 1914. The most ancient skeletal Remains of Man. Smithsonian Rept., pp. xx, 491-552; plates I-XLI; figures 1-12.

---

* MacCurdy, G. G., 1926. Human Origins—A Manual of Prehistory. New York. 2 volumes, illus.

† Hrdlicka, Ales, 1907. Skeletal remains suggesting or attributed to early man in North America. Smithson. Inst., Bur. Ethnol., Bull. 33.

MacCurdy, G. G. 1924. Human Origins. The whole Story of prehistoric Man. New York, 2 vols., 407 figures.

Osborn, Henry Fairfield. 1915. Men of the Old Stone Age. New York. An account of Paleolithic Man.

BIBLIOGRAPHY

A list of important publications relating to the ancient Vertebrates of Indiana.

Balcom, S. F. 1923. The paleolithic stone age in Indiana. Indiana Acad. Sci., Proc. 38th Ann. Meeting, 1922, pp. 105-177, 6 figs. 1923.

Barrel, Joseph. 1916. Influence of Silurian-Devonian Climates on the rise of air-breathing vertebrates. Bull. Geol. Soc. Amer., XXXVII, 387-436.

Branson, E. B. 1905. Notes on some Carboniferous Cochliodonts with descriptions of seven new species. J. Geol., XIII, pp. 20-34, 2 pls.
———. 1905. Fish Remains from the Salem Limestone of Indiana. XXX Ann. Rept. Dept. Geol. & Nat. Res. Ind., pp. 1376-1394, 2 pls.

Claypole, E. W. 1890. Paleontological notes from Indianapolis. Am. Geol., Vol. 5, pp. 255-260, 2 figs.

———. 1894. A new species of Carcinosoma. Am. Geol., 13, pp. 77-79, pl. 4.

Cope, E. D. & Wortman, J. L. 1884. Post-Pliocene Vertebrates of Indiana XIV. Ann. Rept. Dept. Geol. & Nat. Res. Ind., pp. 3-41.

Cumings, E. R. 1922. Nomenclature and description of the geological formations of Indiana. *In* Handbook of Indiana Geology (Indiana Dept. Conservation Pub. No. 21), pp. 403-570, 31 figs.

Gorby, S. S. 1886. The prehistoric Race in Indiana. XVth Ann. Rept. Dept. Geol. & Nat. Res. Ind., pp. 286-313.

Hay, O. P. 1912. The Pleistocene Period and its Vertebrata. 36th Ann. Rept. Dept. Geol. & Nat. Res. Ind., p. 700.

Hay, O. P. 1923. The Pleistocene of North America and its vertebrated animals from the states east of the Mississippi River and from the Canadian provinces east of longitude 95°.
    Carnegie Institution Publ., No. 322.
        Xenarthra, p. 32.
        Mastodons, p. 88.
        Elephas sps., pp. 138, 151, 171.
        Equidae, p. 186.
        Tapirs, p. 203.
        Peccaries, p. 216.
        Deer, pp. 228, 238.
        Musk-ox, p. 251.
        Bison, p. 257, 268.
        Giant Beaver, p. 276.

———. 1925. A further and detailed description of the type of Elephas roosevelti Hay and descriptions of three referred specimens. Proc. U. S. Natl. Mus., Vol. 66, pp. 1-6, 4 pls.

———. 1914. The Pleistocene Mammals of Iowa. Iowa Geological Survey, xxiii, pp. 1-499, pls. 1-74, figs. 1-142.

Haymond, Rufus. 1844. Notices of remains of Megatherium, Mastodon, etc. Am. Jour. Sci., vol. 46, 294-296.

Kindle, E. M. 1898. A catalogue of the fossils of Indiana, accompanied by a bibliography of the literature relating to them. 22nd Ann. Rept., Dept. Geol. and Natl. Resources Ind. List of Vertebrates, pp. 484-485. Bibliography, pp. 489-514.

Moore, Jos. 1890-1893. Papers on *Castoroides*. See Kindle, p. 507.

Newberry, J. S. 1890. The Paleozoic Fishes of North America. U. S. Geol. Surv., Monograph 16.

Norwood, J. G. and Owen, D. D. 1846. Description of a new fossil fish from the Paleozoic rocks of Indiana. Am. Journ. Sci., 2nd ser., I, 367-371, 2 figs.

St. John, Orestes and Worthen, A. H. 1883. Descriptions of fossil fishes. Geol. Surv. Illinois, VII, pp. 57-264.

Stensiö, Erik A.: son. 1925. On the Head of Macropetalichthyids, with certain remarks on the Head of the other Arthrodires. Field Museum of Natural History. Publ. 232. illus.

Taylor, Jay L. B. 1921. Did the Indian know the Mastodon? Natl. Hist., xxi, p. 591, illus.

Thompson, Maurice. 1886. Fossil mammals of the post-Pliocene in Indiana. 15th Ann. Rept. of Ind. Dept. Geol. and Nat. Hist., pp. 283-285.

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THE CERAMIC MATERIALS OF INDIANA

The raw materials suitable for the manufacture of ceramic wares in Indiana include a variety of substances. Clays and shales which are found in the rock strata vary in age from the Pleistocene to the Ordovician. The raw materials include clays and shales from a large number of geological formations, under clays from the Pennsylvanian or Coal Measures, clays from the glacial drift, and kaolin from horizons in the Mississippian and Pennsylvanian strata.

Indiana produces a large variety of ceramic wares and is the 7th state in rank in ceramic production in the United States. The annual production of common, front, glazed, mat, rug, pressed, vitrified, ornamental and fire brick reaches a value of many millions of dollars. The manufacture of agricultural tile, wall tile, floor tile, encaustic tile, fire-proofing, terra cotta, sewer pipe, stove and furnace linings, glass pots and silo staves is of great importance. Pottery products manufactured in the state include earthenware, stoneware, yellow and Rockingham ware, white ware, C. C. ware, white granite, semi-porcelain, sanitary ware and porcelain electrical ware.

The quantity and quality of the raw materials and the abundance of low cost fuels in Indiana justify a much larger production of ceramic wares. Whenever market conditions justify, increased production can be attained in plants already in operation and in those which can readily be established. The object of this circular is to present some of the facts regarding the properties and distribution of the raw materials of the ceramic industry in Indiana.

Geographic Distribution of Materials

All parts of Indiana contain some materials which may be used for some form of ceramic wares. Some of these materials may be used as they are taken from the earth without special preparatory processes, others contain impurities which must be removed before they can be used successfully.

The Borden Shales

The Borden formation contains beds of shale which are serviceable for ceramic purposes. This formation extends from the southernmost point of Harrison County into Jasper County in the northern part of Indiana. The shales have been used for ceramic purposes at a number of points between New Albany in Floyd County and Attica in Fountain County. The outcrop of the formation north of Morgan County is largely concealed by glacial drift except where the major streams have cut through the drift to the bedrock.

The Borden shale and the residual clays from it have been used for a variety of ceramic wares, although its principal uses have been in the manufacture of brick and tile. The varieties of brick which have been manufactured from it include common red brick, vitrified brick, rug, mat and glazed brick. The varieties of tile which have been manufactured include wall tile, floor tile, roofing tile, and sewer pipe.

Laboratory experiments have demonstrated that some of the outcrops of the Borden contain shales which may be used in the manufacture of earthenware and of stoneware. Experiments conducted in the use of some of the more fusible shales have demonstrated that they can be used for slip clays in the preparation of glazes. The glazes produced vary in color from light yellow, through dark browns to black.

Physical Properties. The raw Borden shale is a gray or greenish gray color on recently exposed outcrops. The shale weathers to a yellow colored clay. The color of the product is a light to cherry red at the fusion point of cone 1. Incipient fusion often occurs at this temperature. Vitrification often occurs at cone 5. Chocolate to dark red colors may be obtained in some of the shales at temperatures higher than the fusion point of cone 5. Slip clays and salt glazes may be used with satisfactory results. The linear dry shrinkage ranges from 5 to 7 per cent.

Chemical Composition. The analyses of samples of the Borden shale taken from various points in the outcrop of the formation are given in the following table:

ANALYSES OF SAMPLES OF BORDEN SHALES*

NAME	Town	County	Silica	Titanium oxide	Alumina	Water (Combined)	Clay Base and Sand (Total)	Ferric oxide	Ferrous oxide	Lime	Magnesia	Potash	Soda	Fluxes (Total)	Carbon dioxide
Arthur Hadley	Danville	Hendricks	70.84	.18	14.73	3.32	89.07	....	4.82	.38	1.36	3.15	1.42	11.13	.21
Branch & Son	Martinsville	Morgan	70.60	.43	13.89	3.19	88.11	2.33	3.56	.60	.50	2.76	1.60	11.35	.51
Goetz Dry Pressed Brick Co	New Albany	Floyd	63.88	.91	17.85	4.99	87.63	5.38	....	.38	1.47	3.98	1.29	2.50	....
Jas. McLarey	Bloomington	Monroe	58.22	1.15	19.63	6.61	85.61	5.88	....	1.95	2.10	3.93	.68	14.54	....
W. H. Gregory	Heltonville	Lawrence	68.90	....	17.20	3.97	90.07	5.05	1.05	....	1.95	.85	1.00	9.90	....

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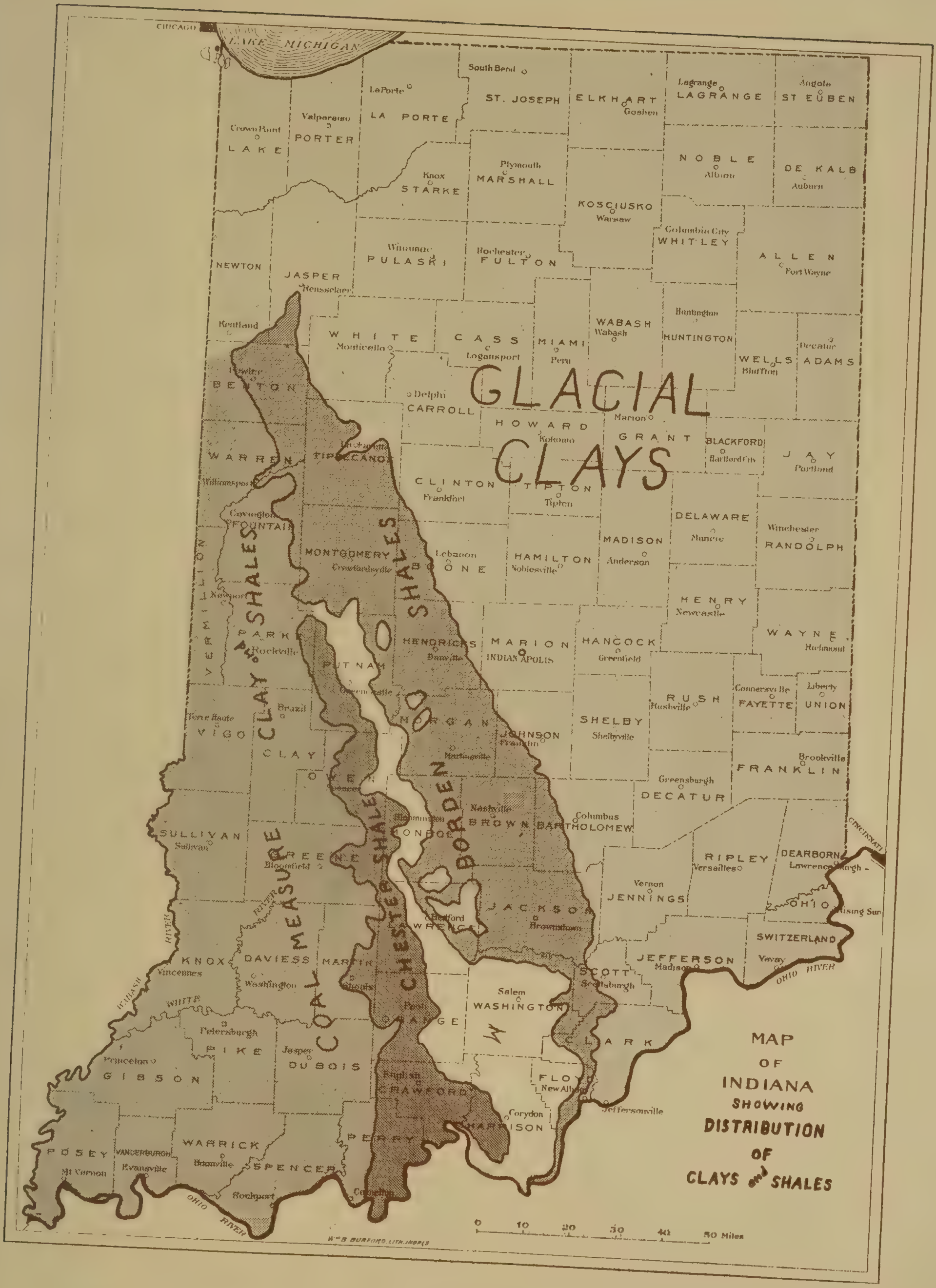
*See Handbook of Indiana Geology, page 649.



MAP OF INDIANA SHOWING DISTRIBUTION OF CLAYS AND SHALES

The Chester Shales

The uppermost beds of the Mississippian rocks in Indiana contain shales, some of which are serviceable for ceramic purposes. These shales outcrop in a belt which extends from the southern portion of Perry County to the southwestern part of Putnam County. Beyond this point the outcrop is concealed by younger formations.

The formations of the Chester which contain shales are the Mooretown, the Sample, the Elwren, the Indian Springs, and there are a number of unnamed shale intervals in the Upper Chester.

Shales from the Chester formations may be used in the manufacture of common, face, and vitrified brick. The color of the ware will vary from nearly pure white to pink or salmon. The shales may be used also in the manufacture of wall tile, floor tile, roofing tile, silo staves, and sewer pipe. Experiments in the laboratory have shown that these shales may be used also in the manufacture of stoneware. In some places these shales appear at the surface near the outcrop of under clays of the Coal Measures, and better ceramic products may be obtained by the mixture of the shales with the clays. Since the quantity and quality of the Chester shales vary much from point to point in the geographical distribution, care should be exercised in the location of plants by first determining the amount and quality of deposit.

Physical Properties. The color of the shales is generally a gray, light blue or light green. Other shades such as yellow, brown, and maroon are present locally. The slaking time varies but is usually low for a shale. The amount of water required for a good degree of plasticity is normally about twenty per cent of the weight of the clay. The loss in weight in passing from a plastic condition to a vitrified product is rarely more than twenty per cent. The color of the more aluminous shales after reaching the vitrified stage is gray or more rarely white. Fluxing substances may produce other colors such as salmon, yellow, pink, or red. The fusion point of the shales of the better grade ranges from pyrometric cone 10 to cone 22. Mixtures of the shale with Indiana halloysite attain higher temperatures.

Chemical Composition. The analyses of five samples of the Chester shales are given in the following table:

ANALYSES OF SAMPLES OF CHESTER SHALE*

CONSTITUENTS	No. 1 Per cent	No. 2 Per cent	No. 3 Per cent	No. 4 Per cent	No. 5 Per cent
Silica	61.24	64.57	58.40	58.68	59.67
Aluminium oxide	18.38	18.67	20.70	21.39	19.75
Iron oxide	4.76	6.22	6.58	6.22	7.32
Calcium oxide	0.70	0.10	0.15	0.14	0.20
Magnesium oxide	1.94	0.65	0.86	0.82	1.02
Alkalies	3.94	2.62	3.16	2.59	2.42
Loss on ignition	10.04	7.17	8.89	8.90	8.60
Sulphur trioxide	.00	tr.	1.26	1.25	1.02
Total	101.00	100.00	100.00	100.00	100.00

*See Handbook of Indiana Geology, page 690.

By weathering and washing the shales thoroughly some impurities may be removed and a more refractory product obtained from the shales in some of the outcrops.

Pennsylvanian (Coal Measure) Shales

The shales which are associated with the coal beds of Indiana are often of a quality which will produce a good ceramic product. These shales are serviceable in the manufacture of tile, paving and building brick, sewer pipe, and silo staves. Ceramic plants which make use of these shales are located for the most part in the area of outcrop of the Pennsylvanian strata. The Montezuma, the Brazil, and the Terre Haute districts are important ceramic centers where these shales have been utilized.

Physical Properties. The color of the shales is gray or bluish gray. The shales are plastic and slake readily under weathering action. The color of the ware varies from light yellow or salmon to dark red. The specific gravity is about 2.40 and the linear shrinkage varies from 6 to 7 per cent. The product usually has light yellow or light salmon color at cone 1, and brownish gray at cone 20. A vitrified ware is produced at the higher temperature.

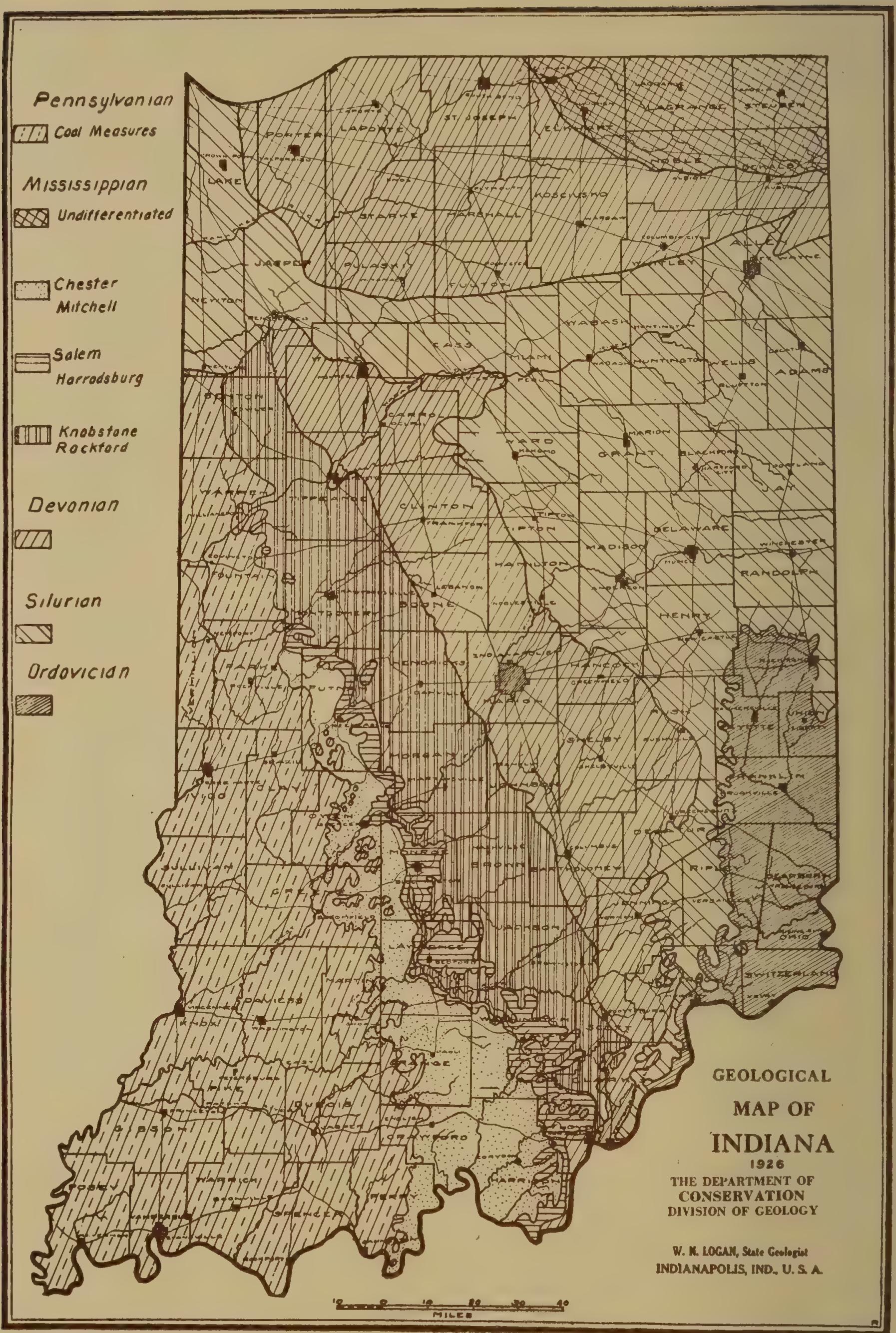
Chemical Composition. The analyses of samples of the Pennsylvanian shales are included in the following table:

ANALYSES OF SAMPLES OF PENNSYLVANIAN SHALES*

NAME	Town	County	Silica	Titanium oxide	Alumina	Water (Combined)	Clay Base and Sand (Total)
Wabash Clay Co.	Veedersburg	Fountain	59.55	1.00	16.21	5.62	82.38
(2) Mecca Coal & Mining Co.	Mecca	Parke	59.77	.8	20.60	4.53	85.70
(6) Burns & Hancock Land	Montezuma	Vermillion	46.07	1.19	24.22	9.76	81.24
Buckskin Mine	Buckskin	Gibson	57.60	.89	24.74	8.14	91.37
American Cannel Coal Co.	Cannelton	Perry	53.26	1.05	25.77	7.00	87.08

NAME	Ferric oxide	Ferrous oxide	Lime	Magnesia	Potash	Soda	Fluxes (Total)	Carbon dioxide
Wabash Clay Co.	2.18	7.13	.75	1.58	2.81	.28	14.73	3.15
(2) Mecca Coal & Mining Co.	2.22	3.70	.64	1.98	3.10	.85	12.49	.90
(6) Burns & Hancock Land	9.65	.34	.19	1.31	1.66	2.76	15.91	2.87
Buckskin Mine	.15	2.41	.70	1.20	3.40	.99	8.85	....
American Cannel Coal Co.	3.32	3.82	.32	1.90	2.54	.44	12.34	1.10

*See Handbook of Indiana Geology, page 649.


GEOLOGICAL MAP OF INDIANA 1926
THE DEPARTMENT OF CONSERVATION
DIVISION OF GEOLOGY

W. N. LOGAN, State Geologist
INDIANAPOLIS, IND., U. S. A.

Pennsylvanian Under Clays

Beneath many of the coal beds of the Pennsylvanian formations of Indiana are beds of plastic gray clays which supply some of the most important ceramic materials of the state. The thickness of the beds of clay varies from a few feet to eight feet. These clays may be used in the manufacture of a large list of ceramic products, among others wall, roof and floor tile, pottery, terra cotta, sewer pipe, face, common, front and glazed brick, electric conduits, silo staves, flue linings, coping and culvert pipes.

Physical Properties. The under clays have an excellent degree of plasticity, are fine of grain, and are generally free from concretions or particles which are likely to cause imperfections in wares. They are gray in color, imperfectly laminated, and have a smooth, soap-like feel. They are often irregularly jointed and slicken-sided. The linear dry shrinkage is generally under five per cent. The color of the product at cone 1 is white and often remains white up to cone 20. The fire shrinkage is usually less than three per cent, and the loss of volatile matter less than six per cent. The clay usually vitrifies at cone 20 and presents a strong body free from imperfections.

Chemical Composition. The composition of the under clays is variable. Variations occur as between beds and between points in the same bed. The percentage of alumina is usually between 20 and 25; silica between 58 and 65; the fluxes between three and four; and the loss on ignition between seven and ten.

The analyses of samples of the under clays are contained in the following table:

ANALYSES OF SAMPLES OF PENNSYLVANIAN UNDER CLAYS*

NAME	Town	County	Silica	Titanium oxide	Alumina	Water (Combined)	Clay Base and Sand (Total)
John R. Teegarden	Kingman	Fountain	71.91	.31	17.62	5.37	95.21
No. 12 Mecca Coal & Mining Co.	Mecca	Parke	54.46	1.20	25.71	8.50	89.87
Cayuga Brick & Coal Co.	Cayuga	Vermillion	55.09	1.20	20.76	7.01	84.06
Potters Clay-Bockting Bros.	Huntingburg	Dubois	69.23	1.50	18.97	5.46	95.16
American Cannel Coal Co.	Cannelton	Perry	57.59	1.10	21.70	6.78	87.15

NAME	Ferric oxide	Ferrous oxide	Lime	Magnesia	Potash	Soda	Fluxes (Total)	Carbon dioxide
John R. Teegarden	2.55	.40	.43	.17	2.00	.15	5.70	....
No. 12 Mecca Coal & Mining Co.	5.51	.91	.24	.83	2.68	.33	10.50	....
Cayuga Brick & Coal Co.	3.00	4.01	1.51	1.18	2.36	.34	12.40	3.04
Potters Clay-Bockting Bros.	1.57	.55	.12	.36	2.27	.33	5.20	....
American Cannel Coal Co.	2.26	4.11	.32	1.12	2.16	.33	10.30	1.73

*See Handbook of Indiana Geology, page 650.

Pleistocene and Recent Clays

Surface clays in many parts of the glaciated region have been used in the manufacture of brick and agricultural tile. In the non-glaciated region of Indiana there are residual clays derived from the decomposition of limestones and other clay-bearing rocks. These clays have been used in the manufacture of common brick and drain tile.

Physical Properties. These clays vary much in their physical properties due to the conditions under which they have been formed. Some of the glacial clays are high in lime and fuse at low temperatures. Some have a high silica content and are lacking in bonding power. Others contain coarse particles which interfere with the processes of manufacture. Other deposits are plastic, have good bonding and drying qualities, and produce a satisfactory product without expensive preparatory processes.

Chemical Composition. The analyses of some samples of the Pleistocene and Recent clays are given in the following table:

ANALYSES OF SAMPLES OF PLEISTOCENE AND RECENT CLAYS*

NAME	Town	County	Silica	Titanium oxide	Alumina	Water (Combined)	Clay Base and Sand (Total)
Surface Drift	Rockville	Parke	66.84	....	13.64	4.22	84.70
Surface Loess	Princeton	Gibson	71.20	.88	18.56	6.30	96.94
National Stone Co	Bloomington	Monroe	72.56	.31	10.44	4.54	87.85
Jessup Land	Richmond	Wayne	67.76	.89	13.69	7.10	89.44
Roeske Bros	Michigan City	Laporte	50.47	1.45	12.77	3.14	67.83

NAME	Ferric oxide	Ferrous oxide	Lime	Magnesia	Potash	Soda	Fluxes (Total)	Carbon dioxide
Surface Drift	9.40	....	1.36	Tr.	.64	3.34	14.74	....
Surface Loess	1.34	.15	.14	.52	.32	1.26	3.73	....
National Stone Co	7.45	.43	.82	1.09	2.05	.73	12.57	....
Jessup Land	5.09	.46	.94	.51	3.26	.51	10.77	....
Roeske Bros	2.44	2.52	8.17	5.22	3.70	.73	22.78	9.80

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*See Handbook of Indiana Geology, page 650.

Production of Clays and Clay Products in Indiana

Raw clays are produced in Indiana and used for ceramic purposes in other states. The amount of such clay reaching the market each year depends upon the general commercial condition. The amount of clay disposed of in this way is between 200,000 and 250,000 short tons annually and the value is generally in excess of one dollar per ton.

Clay Products. Indiana is an important producer of ceramic products. Among the states it ranks seventh in the value of these products. The number of firms which report the production of clay wares is 94. The value of the brick and tile produced in Indiana annually is $14,230,400.00. The value of ceramic products listed under pottery is $3,625,571.00 per year. The total value of all ceramic products is $17,855,971.00.

AVAILABLE GEOLOGICAL REPORTS

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The reports and maps listed below may be obtained from the office of the State Geologist, Room 135, State Capitol.

Separate volumes including the reports of the State Geologist were published until 1916. The following are available:

7th (1875)	$2.00
15th (1885-6)	.50
16th (1888)	.50
17th (1891)	.50
19th (1894)	.50
21st (1896)	2.50
23rd (1898)	10.00
24th (1899)	$2.00
25th (1900)	2.00
26th & 27th (1901-2)	3.00
30th (1905)	3.00
39th (1914)	1.50
40th (1915)	.50
41st (1916)	free

Recent annual reports of the State Geologist, including miscellaneous papers, have been published in the following available reports of the Conservation Department, which are free:

3rd (1921) Gold in Indiana; The New Providence Shale; The St. Louis ls.
4th (1922) The New Albany Shale; Peat Deposits of Indiana.
5th (1923) Petroleum Conservation.
6th (1924) Laws Affecting Oil and Gas Operations in Indiana.
7th (1925) Coal Losses of Indiana.
8th (1926) Report on Indiana Caves, including Marengo.
9th (1927) Subterranean Drainage Phenomena.
10th (1928) Geological Conditions in the Siosi Oil Field.
11th (1929) The Mineral Fuel Resources of Indiana.

The following special reports have been published separately:

Kaolin in Indiana (1919)—$0.25.

Handbook of Indiana Geology (1929)—$3.00 in Indiana; $5.00 to non-residents. Includes geography, physiography, hydrology, stratigraphy, paleontology, economic geology and oil shales of Indiana.

Petroleum Industry in Indiana in 1923—free.

Geological Conditions in the Oil Fields of Southwestern Indiana (1924)— $0.50 in Indiana; $0.75 to non-residents.

Laws and Regulations Affecting Oil and Gas Operations in Indiana (1924)—free.

Geology of the Deep Wells of Indiana (1926)—$1.00.

Regulations concerning plugging of abandoned gas and oil wells and filing of deep well records, with blank well log forms—free.

Geology of the Silurian Rocks of Northern Indiana (1928)—$1.00.

Indiana Oolitic Limestone Map of Lawrence County (1928)—$1.00 on bond stock, $2.00 on enamel stock.

Indiana Oolitic Limestone Map of Monroe-Owen Counties (1928)—$1.00 on bond stock, $2.00 on enamel stock.

The Geological History of the Vertebrates of Indiana (1929)—Cloth bound, $1.25; Paper bound, $1.00.

U. S. Geological Survey topographic sheets of portions of Indiana are sold through this office for 10c each.

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The Foundry Sands of Indiana

By

W. N. LOGAN

DIVISION OF GEOLOGY
W. N. LOGAN, State Geologist

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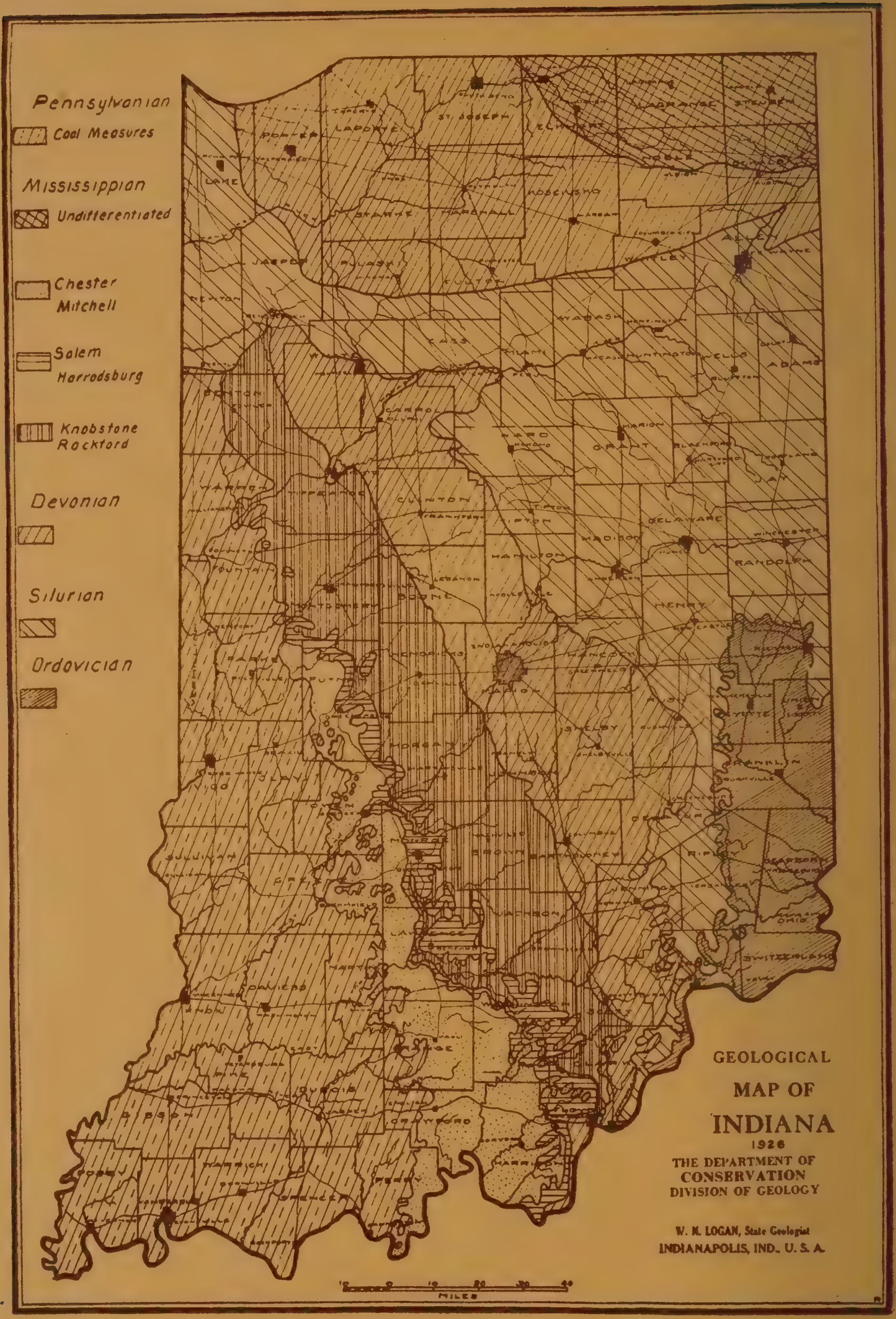
Pennsylvanian
Coal Measures
Mississippian
Undifferentiated
Chester
Mitchell
Salem
Harrodsburg
Knobstone
Rockford
Devonian
Silurian
Ordovician
GEOLOGICAL
MAP OF
INDIANA
1926
THE DEPARTMENT OF
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DIVISION OF GEOLOGY
W. N. LOGAN, State Geologist
INDIANAPOLIS, IND. U. S. A.
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MILES
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THE FOUNDRY SANDS OF INDIANA

By W. N. Logan

Sands or mixtures of sand, silt and clay are used in foundries for the making of molds in which metals are cast, or in the making of cores which are used to fill the spaces intended to be voids in casting. The sands used in the making of cores are of coarse texture, that is, composed of grains of medium or large size. These grains are often bound together by an artificial binder. The sands used for molds are generally of finer texture and may contain a clay binder which holds the grains together. Molding sands of fine texture are used especially for small castings. Sands used for making molds for large castings are often of coarser texture. Molds used in the manufacture of some castings may be faced with a refractory mineral such as graphite.

Properties of Foundry Sands. The chemical and the physical properties of foundry sands must be considered in determining the value of sands for foundry use. The physical properties which are generally considered in determining the value of a sand for foundry uses includes refractoriness, cohesiveness, fineness of grain, permeability, and durability.

Refractoriness. Sands which contain substances that are easily fused at low temperatures cannot be used for the making of molds. Sands occasionally contain a number of minerals or substances which will fuse or be destroyed by the temperature of molten metal. Among these are calcium carbonate, iron compounds, carbon and hydrocarbon compounds. Such substances may permit the union of the metal with the mold or may permit the penetration of the mold by the metal.

Cohesiveness. In order that a mold may assume the proper shape and retain that shape until the metal has been poured into it the individual grains of the foundry sand must be held together by some sort of bonding material. The substance which serves this purpose to best advantage in molding sands is clay. It bonds the grains of silica together and is relatively infusible.

Fineness of Grain. The mechanical analysis or the separation of the constitutent particles of a molding sand in divisions of a certain uniformity of size is an aid to the determination of the usefulness of molding sands for specific purposes. The mechanical analysis may be made by passing a given amount of the sand through a set of sieves of known mesh and by computing the amount retained on each sieve. A comparative separation may be obtained by the use of a vibrator which will keep the particles of sand agitated in water until they settle in order of their weights. This method is more rapid and produces a separation of sand, silt and clay.

Permeability. Sands used for foundry purposes must be porous enough to permit the passage of gases through the molds. These gases may issue from the molten metal. They may be from the cushion of air on the face of the mold or they may be from the air within the pores of the mold. Gases may be created within the mold by the influence of the heat of the molten metal on moisture, hydrous minerals, or colloidal substances. The mold must be permeable enough to carry off such gases to prevent the disruption of the mold and the penetration of the metal.

Durability. Foundry sands to be used economically should possess properties which will permit them to be used again and again. Foundry sands differ greatly in durability. Some sands may be used so long as there is enough of the material remaining to complete the mold. Others are easily renewed by adding a small amount of fresh sand. Others have their usefulness destroyed by being used only a few times. Careful experimental work in the foundry is necessary to determine the length of life and the possibilities of renewal of a given sand.

Molding Sands. Foundry sands used in the manufacture of molds have different compositions and different physical properties than those sands used in the manufacture of cores. Molding sands contain a natural binder which is usually silt or clay, though other substances may contribute to at least a small degree. Good molding sands possess a proper balance between sand and bond. Too much silt or clay may fill all the space between sand grains and prevent the escape of gases. Coarse sand will require more bond than fine sand.

Core Sands. Core sands are coarser than molding sands and in addition to the small amount of natural bond which may be present they require an artificial binder. This binder must hold the sand grains together without completely filling the interstices and preventing the escape of the gases. When the core has been shaped the binder must harden sufficiently to form a coherent body which can easily be separated from the casting. Core sands should be selected to meet the requirements of the metal to be cast. The materials should be thoroughly mixed and tempered.

Mold Facing Materials. When a mold has been completed it may be faced by using pulverized minerals. Substances used include graphite, pulverized coal (sea-coal), talc, fire clay, asphalt, resin and other substances. Molasses water and kerosene are used for sponging the surfaces of some molds after they have been completed.

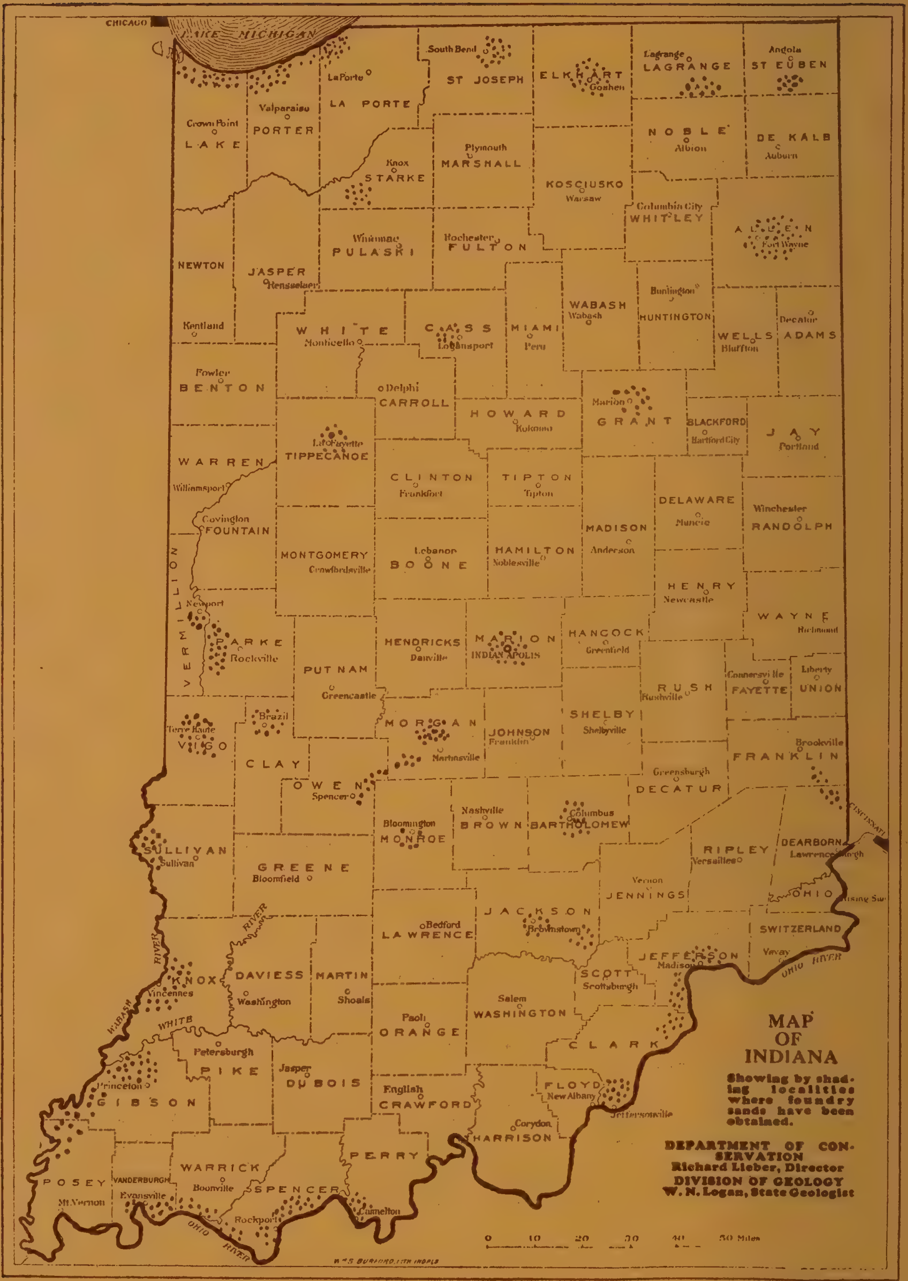
Blended or Synthetic Sands. Many natural deposits of sand contain the ingredients suitable for a good molding sand but unfortunately they are often mixed with undesirable materials. Such deposits are often utilized for foundry sands by washing, drying, and screening to separate the particles into standard sizes, and then thoroughly mixing the sand, silt and clay in the proper proportion for the product desired.

Uses of Indiana Foundry Sands. The foundry sands of Indiana are used in the making of molds and in the making of cores. The molding sands may be used in the making of molds for the casting of aluminum, brass, malleable iron, stove plate, medium gray iron, heavy gray iron, furnace castings, typewriter castings, light hardware, auto castings, heavy car castings, radiator castings and heavy machinery castings.

Geological Distribution. Many formations in Indiana produce sands which are suitable for foundry purposes when the rocks of these formations are disintegrated under the influence of weathering. These residual materials are in some localities naturally blended by the sorting action of running water but as a rule preparatory methods must be used before they can be utilized. The larger part of the sands of the residual type belong to the post-Pleistocene epoch of geological time though some of them are doubtless of Pleistocene and pre-Pleistocene age.

Geographical Distribution. Foundry sands are widely distributed in Indiana. There are few, if any, counties in the state which do not contain some materials that are suitable for foundry purposes. In many of the counties are natural deposits which may be used for foundry sands as they are taken from the pits. The counties in which commercial quantities of foundry sands have been found include: Allen, Bartholomew, Cass, Clark, Clay, Elkhart, Gibson, Grant, Harrison, Henry, Jackson, Jefferson, Knox, Lagrange, Lake, Laporte, Marion, Morgan, Monroe, Newton, Owen, Porter, Starke, St. Joseph, Spencer, Steuben, Sullivan, Tippecanoe, Vanderburg, Vermillion, and Vigo.

The localities near which foundry sands have been produced in Indiana include: Fort Wayne and New Haven in Allen County; Columbus in Bartholomew County; Lake Cicott in Cass County; New Albany in Floyd County; Brazil in Clay County; Goshen in Elkhart County; Marion in Grant County; Newcastle in Henry County; Brownstown and Seymour in Jackson County; Madison in Jefferson County; Vincennes in Knox County; Wolcottville in Lagrange County; East Gary and Hammond in Lake County; Michigan City in Laporte County; Indianapolis in Marion County; Bloomington in Monroe County; Centerton, Landersdale, and Paragon in Morgan County; Gosport and Spencer in Owen County; Valparaiso in Porter County; Mishawaka and South Bend in St. Joseph County; Richland Junction, Rockport, and Grand View in Spencer County; North Judson in Starke County; Pleasant Lake in Steuben County; Merom in Sullivan County; Lafayette in Tippecanoe County; Evansville in Vanderburg County; Hillsdale in Vermillion County; and Terre Haute in Vigo County.



MAP OF INDIANA

Showing by shading localities where foundry sands have been obtained.

DEPARTMENT OF CONSERVATION
Richard Lieber, Director
DIVISION OF GEOLOGY
W. N. Logan, State Geologist

Analyses of Indiana Foundry Sands.

A large number of samples of Indiana foundry sands have been tested in foundries and in laboratories. The Division of Geology has been conducting investigations of Indiana foundry sands in the field and laboratory for a number of years. During the field work samples of foundry sands are collected. These samples are being analyzed in the laboratory as time from other duties permits. When the work is completed a report will be published. A brief report on the foundry sands of Indiana was published in the "Handbook of Indiana Geology" in 1922, a publication of the Division of Geology of the Indiana Conservation Department.

In a book entitled "Foundry Sand, Its Uses and Abuses", published by Eugene W. Smith, General Foundry Superintendent, Crane Company, Chicago, some Indiana foundry sands are discussed as follows:

"Indiana has a plentiful supply of good molding sands of every known grade and suited to all grades of castings, from the lightest of hardware to the heaviest machinery castings......

"Dyeton Sand (Whitewater and Ohio Valleys) Vibratory test: Bond, 47.36%; Silica, 52.64%. Color, dark yellow......useful for light carriage work, auto trimmings, typewriter castings, name plates, and such work as requires japanning or plating."

Spencer County. "Luce Township, No. 1. Bond, 24.24%; Silica, 75.75%. Color, light brown......open fine sand, very uniform in grain, should prove an excellent sand for brass and aluminum.

"......Sandale A-1. Bond, 29%; Silica, 71%......one of the few fine sands, having no excess of bond......should prove an excellent sand for light novelty work......wear well and give excellent results where plating is required.

"......Sandale A-1. Open. Bond, 25%; Silica, 75%......carries all of the characteristics of the A-1 Sandale but has a slight advantage in that is carries a slightly less bond.

"......Sandale Special 00. Bond, 30%; Silica, 70%......a strong bond, fine sand, suitable for stove plate and light hardware......good sand for brass work, but for aluminum a more open sand combination would be required......

"......Diamond H Sandale. A strong bond, fine sand of about the same texture as the Special 000 but a little more open......suitable for stove plate, malleable, brass, and light hardware requiring plating, enameling, etc.

"......Sandale No. A-B. Bond, 25%; Silica, 75%......a medium fine sand, suitable for light bench work, machine molding or brass...... compares favorably with best of Indiana or Kentucky fine sands......

"......Luce Township No. 5. Bond, 30.90%; Silica, 69.09%. Color, dark brown. This is a strong, open, medium grain sand, having a composite fine of 29%......an excellent sand for heavy bench or floor molding......

"......Luce Township No. 1½. Bond, 44.73%; Silica, 55.26%. Color bond, yellow; silica, dark yellow......extremely fine sand, suitable for brass and non-ferrous metals only......"

Perry County. "Troy T-5. Bond, 33%; Silica, 67%. Bond, dark yellow; silica, brown......a medium heavy grain, strong, open sand, and should prove suitable for general casting, bench, floor and machine molding."

LaPorte County. "Wanetah sand. Bond, 24%; Silica, 76%. This is an extremely open sand of very even texture and medium grain......one of the most useful sands in the country, particularly in the surrounding States, where the average molding sands are too high in bond...... Valuable as an opener for facing sands and may be used on any class of work from one pound castings up to 500 pounds......too fine in grain for heavier castings than 500 lbs."

Floyd County. "Local sand, specimen not graded. Color, dark. Bond, 24.48%; Silica, 75.51%. This is a heavy, open grained, strong sand, suitable for heavy machinery and the rougher forms of floor work......"

Morgan County. "Centerton Bradford sand. Bond, 30.76%; Silica, 69.23%. Color, light brown. This is a splendid grade of medium heavy grain, open and strong sand. It is suitable for heavy bench molding, also floor work, general machinery and car work, when used alone. It is a little too coarse for light castings where a finish is required. It is an excellent opener for prepared facings for use on castings up to eight or nine hundred pounds. The wearing qualities are excellent and it should work well in combination with Illinois or Wisconsin sands. It will stand very hard ramming or pressures."

St. Joseph County. "Mishawaka River Grove sand (Core). Bond, 22.50%; Silica, 77.50%. This sand is of the same texture and grain as the Custer Park sand. It makes a good core-sand but care must be taken with the binder used or cores will become too close. It is not advisable to use this as a molding sand inasmuch as it weakens so easily on account of fineness of grain."

Porter County. "Custer Park sand. Bond, 14.28%; Silica, 85.71%. This is a fine, open grained sand, usually used as a core-sand, where unusually fine finish is desired, but on account of its excess fineness it would not be safe to use for anything heavy. This sand must be handled with care as it will weaken easily. It makes a splendid core-sand, but cores vented and binder not used too strong. It is usually used for stand-up cores."

Cass County. "Lake Cicotte. Bond, 7.40%; Silicia, 92.50%. This is a wonderfully even grained fine sand, suitable for light cores made in driers or one-half cores on plate. The bond is not sufficient for stand-up cores and for the same reason it is not suitable for a molding sand, unless blended with a stronger grade of fine sand, where an opener is needed. It has a composite fine of 70%."

Gibson County. "Patoka No. 1. Bond, 27.58%; Silica, 72.41%. This is an even grained extremely open strong bond sand, suitable for radiator castings and all classes of work which require hard ramming or pressures, or deep pocket work. It is useful as an opener for the medium class of castings....is of the same character as the Wanetah or Canadian sands.

"......Patoka No. 2. Bond, 18.36%; Silica, 81.63%......same general texture as No. 1 Patoka, excepting that it has less bond and is suitable for the same general class of work. It is an even grained, medium strong and open sand.

"......Patoka No. 3. Bond, 17%; Silica, 82%......same characteristics as the No. 1 and No. 2 Patoka but is much finer in grain...... an open strong sand.

"......Patoka No. 5. Bond, 68.42%; Silica, 31.57%......an extremely fine sand and while it also is a strong sand it is not advisable to use on any form of castiron work......

"......Patoka No. 6. Bond, 23.66%; Silica, 73.33%......an open, strong, medium heavy grained sand, useful for medium castings, bench, machine and floor molding. This sand has a very even texture and should provide a good finish to general castings. If excessive core work is used a good binder should be at hand."

The accompanying analyses of Indiana foundry sands were made by the American Foundry Association, the results being obtained through Mr. P. Willard Crane.

RESULTS OF TESTS ON INDIANA MOLDING SANDS

Laboratory Number	Grade if Used		Screen Analysis												Water Per cent	Bond Strength	Permeability
			On 6	On 12	On 20	On 40	On 70	On 100	On 140	On 200	On 270	Through 270	Clay	Total			
81	Clark Co. Jeffersonville	Produced				.06	.12	.18	.57	1.97	4.96	84.30	7.84	100.00	4.4 5.9 7.1 8.0	134 143 156 159	5.06 5.76 5.65 5.50
6-A	Gibson Co. Patoka	Produced			4	10.6	30.0	20.4	8.8	2.4	1.3	19.6	6.5	100.00	5.2 7.0 8.8	264 302 214	84.0 113.0 76.0
23	Perry Co. Troy	Produced				2.3	22.0	13.8	5.2	2.3	1.0	38.6	14.8	100.00	5.9 7.1 8.0 9.5	230 250 254 268	5.1 5.5 14.0 13.9
24	Perry Co. Troy	Produced				.1	.2	.2	.2	.3	.4	72.4	26.2	100.00	5.9 7.2 7.7 9.1	277 307 290 274	2.6 5.7 2.8 2.4
25	Perry Co. Troy	Produced				5.6	36.1	11.8	3.5	1.2	.7	22.0	19.1	100.00	6.7 7.1 8.0 9.2	250 319 255 250	12.8 23.0 52.0 37.8
26	Perry Co. Troy	Produced				4.5	43.2	23.6	6.2	2.1	.7	5.3	14.4	100.00	5.3 6.0 7.1 9.8	327 342 366 305	303.0 116.0 117.0 125.0
7-A	Spencer Co. Rockport	Produced					.4	.4	.6	.6	2.4	82.8	12.8	100.00	3.9 5.8 7.9 9.5	213 309 243 238	3.62 5.85 3.51 3.44
5-A	Spencer Co. Rockport	Produced					3.0	7.4	11.0	4.2	3.7	65.1	5.6	100.00	4.0 5.7 6.6 7.7 10.2	135 152 159 173 176	3.58 4.16 4.85 5.22 4.18
8-A	Spencer Co. Rockport	Produced				.2	3.2	8.6	11.4	4.4	3.0	62.4	6.8	100.00	4.0 5.1 7.6 9.5	170 190 197 209	3.9 4.7 6.8 10.0
4-A	Spencer Co. Rockport	Produced					1.8	4.4	6.0	2.6	6.4	71.6	7.2	100.00	3.9 6.6 8.1	169 238 273	3.48 7.12 6.25
3-A	Spencer Co. Rockport	Produced					.4	1.0	3.0	2.2	5.4	79.2	8.8	100.00	4.4 6.1 8.4	173 228 227	4.25 7.14 3.52
2-A	Spencer Co. Rockport	Produced						.2	.2	5.0	3.0	72.0	19.6	100.00	4.3 7.0 8.6 10.4	193 197 270 244	1.33 1.67 2.08 1.60

Molding Sand Production

Indiana ranked second in quantity production of molding sand in 1926. The value of the molding sand produced in the State during that year was $356,921. In 1924 and in 1925 it held fourth rank in quantity production, producing more than 400,000 tons. In 1928, the sales of molding sand by producers in Indiana totaled 361,740 tons, valued at $202,052.

Molding Sand Producers in Indiana

Allen County, New Haven, Bates Gravel Company.
Allen County, Ft. Wayne, B. and B. Sand and Gravel Company.
Allen County, Ft. Wayne, Spy Run Sand and Gravel Company.
Allen County, Ft. Wayne, Stuck Sand and Gravel Company.
Clark County, Jeffersonville, W. T. Ingram.
Clark County, New Albany, Newport Sand Bank Company.
Clark County, Jeffersonville, John Sames.
Clark County, Jeffersonville, John W. Taylor.
Gibson County, Patoka, Houghland and Hardy. Office at Evansville.
Jackson County, Brownstown, Phillip Grosman.
La Porte County, Michigan City, Pinkston Coonrad.
La Porte County, Wanetah, Wanetah Molding Sand Company.
Morgan County, Centerton, Bradford Sand Company.
Porter County, McCool, J. S. Robbins.
Perry County, Troy, Houghland and Hardy.
Spencer County, Rockport, Walker Sand Company.
Spencer County, Rockport, Rockport Molding Sand Company.
Spencer County, Tell City, Houghland and Hardy.
Spencer County, Rockport, Houghland and Hardy.
Starke County, North Judson, C. W. Weninger.
St. Joseph County, South Bend, Chas. Smith.
St. Joseph County, South Bend, Chas. Whiteman.
St. Joseph County, South Bend, F. S. Ritter.
Vigo County, Terre Haute, Houghland and Hardy.

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AVAILABLE GEOLOGICAL REPORTS

The reports and maps listed below may be obtained from the office of the State Geologist, Room 135, State Capitol.

Separate volumes including reports of the State Geologist were published until 1916. The following are available:

7th (1875)	$2.00	24th (1899)	$2.00
15th (1885-6)	.50	25th (1900)	2.00
16th (1888)	.50	26th & 27th (1901-2)	3.00
17th (1891)	.50	30th (1905)	3.00
19th (1894)	.50	39th (1914)	1.50
21st (1896)	2.50	40th (1915)	.50
23rd (1898)	10.00	41st (1916)	free

Recent annual reports of the State Geologist, including miscellaneous papers, have been published in the following available reports of the Conservation Department, which are free:

3rd (1921) Gold in Indiana; The New Providence Shale; The St. Louis ls.
4th (1922) The New Albany Shale; Peat Deposits of Indiana.
5th (1923) Petroleum Conservation.
6th (1924) Laws Affecting Oil and Gas Operations in Indiana.
7th (1925) Coal Losses of Indiana.
8th (1926) Report on Indiana Caves, including Marengo.
9th (1927) Subterranean Drainage Phenomena.
10th (1928) Geological Conditions in the Siosi Oil Field.
11th (1929) The Mineral Fuel Resources of Indiana.

The following special reports have been published separately:

Kaolin in Indiana (1919)—$0.25.

Handbook of Indiana Geology (1922)—$3.00 in Indiana; $5.00 to non-residents. Includes geography, physiography, hydrology, stratigraphy, paleontology, economic geology and oil shales of Indiana.

Petroleum Industry in Indiana in 1923—free.

Geological Conditions in the Oil Fields of Southwestern Indiana (1924)—$0.50 in Indiana; $0.75 to non-residents.

Laws and Regulations Affecting Oil and Gas Operations in Indiana (1924)—free.

Geology of the Deep Wells of Indiana (1926)—$1.00.

Regulations concerning plugging of abandoned gas and oil wells and filing of deep wells records, with blank well log forms—free.

Geology of the Silurian Rocks of Northern Indiana (1928)—$1.00.

Indiana Oolitic Limestone Map of Lawrence County (1928)—$1.00 on bond stock, $2.00 on enamel stock.

Indiana Oolitic Limestone Map of Monroe-Owen Counties (1928)—$1.00 on bond stock, $2.00 on enamel stock.

The Geological History of the Vertebrates of Indiana (1929)—Cloth bound, $1.25; Paper bound, $1.00.

The Ceramic Materials of Indiana (1929)—free.

U. S. Geological Survey topographic sheets of portions of Indiana are sold through this offce for 10c each.

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THE CORYDON STATE HOUSE

A Hoosier Shrine

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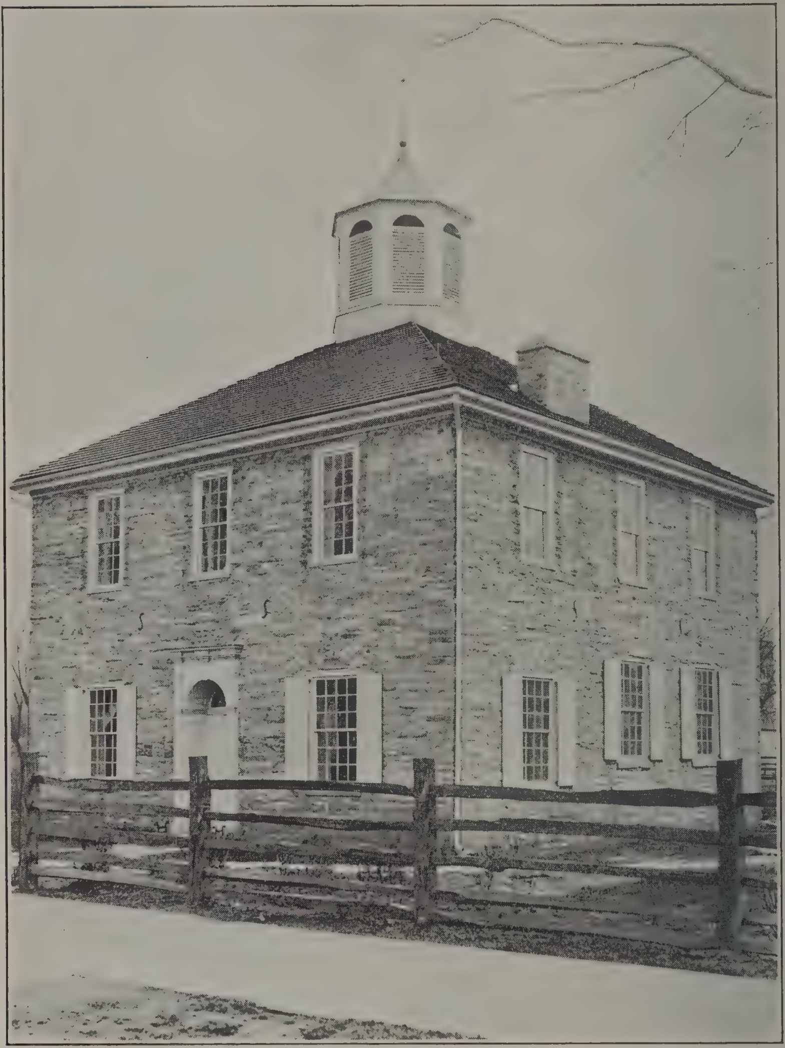
The
DEPARTMENT OF CONSERVATION
STATE OF INDIANA
1930

BIOLOGY



THE CAPITOL BUILDING AS RESTORED

The CORYDON STATE HOUSE

A Hoosier Shrine

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By GEORGE S. COTTMAN

PUBLICATION NUMBER 94
THE DEPARTMENT OF CONSERVATION
STATE OF INDIANA
DIVISION OF LANDS AND WATERS

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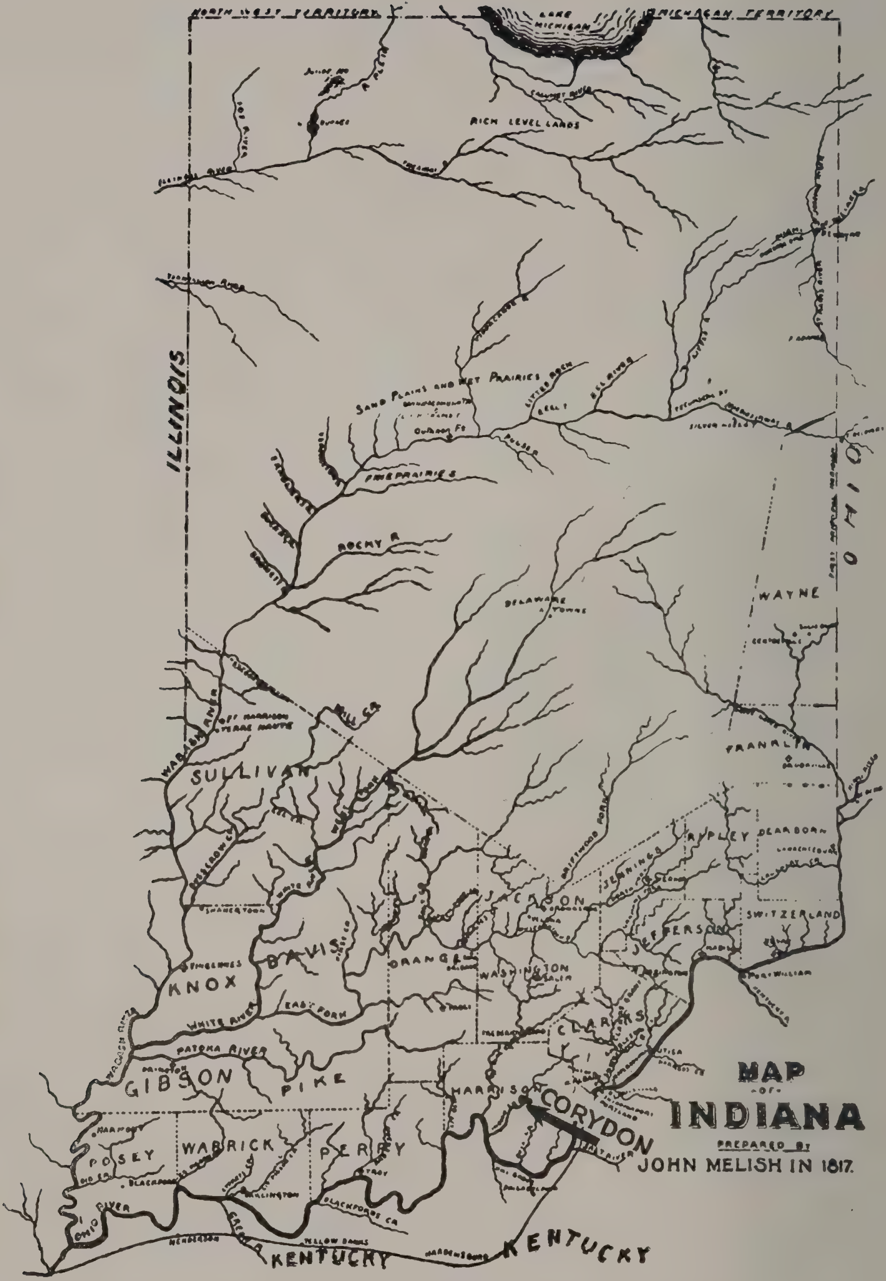

FIRST MAP OF STATE OF INDIANA
(See page 53)

A HOOSIER SHRINE

By Geo. S. Cottman

THE BACKGROUND

To the uninformed within or without our borders who may not know why a certain old stone building in the little hill town of Corydon, Indiana, should be especially honored by the state, this introduction is written. Also it is a background that may be helpful to a fuller understanding of the narrative proper.

The story of it, filled out, goes back to that dramatic event of which we have heard much lately, the conquest of the Northwest by George Rogers Clark and his handful of valorous backwoodsmen—an exploit that secured for the future nation of the United States not less than a quarter of a million square miles. From the western boundary of Pennsylvania to the Mississippi River, from the chain of inland seas to the Ohio River stretched this vast domain, spacious enough of itself to make a separate empire. Hemmed in by navigable waters, blessed with countless natural resources, it was destined to be the home of teeming multitudes and the seat of five great states shaped to the democratic ideal, and which should lead the rest of the nation in the direction of universal freedom.

From the time the United States took possession of this region as a grant from Virginia to the present moment one great unfolding process has been going on. Not only has the wilderness been made to blossom as the rose for the benefit of mankind but, socially and politically, there has been a segregation and crystallization, a growing from the simple to the complex, a progress from paternalistic dependence to self-determining independence. What began as the Northwest Territory, inchoate and tentative, gradually divided and subdivided until the five separate areas we now call States took their fixed boundaries, and the one original political unit became five units, each independent of the others.

These mutations were all according to plans and specifications. From the beginning the goal was statehood—a group of states—and to shape the character of those states a special instrument was framed. This known as the "Ordinance of 1787," not only laid the foundation for and made mandatory a republican form of government consonant with the Federal Constitution, but it also barred the way against the institution of slavery, which elsewhere had its clutches on the throat of the young nation. A few pregnant words incorporated in the Ordinance—"There shall be neither slavery nor involuntary servitude in the said territory,"—went far toward determining the character of the population that came flowing in from the south and east as the new country was opened up for settlement, and so fixed the status of its civilization for future time. To those like-minded immigrants, haters of slavery and seekers of a land where they could work out their higher ideals, the future was bright with promise.

We may more fully appreciate the meaning of independent statehood if we consider the successive steps through which it was attained after the formation of our nation, when the organization of a public domain became one of the governmental questions. These steps, in the case of Indiana, were as follows: When first organized under that name, in 1800, it consisted of all the territory won by Clark, with the exception of what is now Ohio. Then came divisions, as the population increased, one made in 1809 reducing the once vast Indiana to, virtually, its present dimensions. The territory, as such, passed through two forms or grades of government, the first being administered by a governor and three judges of federal appointment, and these changing to a governor and legislative council, who were appointees; a house of representatives elected by the people, and a delegate to Congress elected by the legislature. With the granting of statehood all federal jurisdiction was withdrawn and the whole governing body was chosen by the people. The latter status was much like that of a boy attaining his majority and leaving the parental roof to face for himself the responsibilities of life. Thus it may be assumed that after sixteen years of preparation, while the proper growth was making, the final attainment of statehood had its inspiration and hope for the forward-looking majority. The majority, it is said, because until the last moment there were timorous souls who feared to take up the burden of new responsibilities with their increase of taxation. Such, however, were a small minority.

And there were reasons for inspiration and hope. The Indianans had the smallest of the five states of the group, but, as fortune would have it, we lay directly in the line of that vast tide of commerce that in time to come was to sweep to and fro between an East more opulent than the orient of Marco Polo and a West more glamorous in its potential wealth than any El Dorado of the imagination. Wedged in between the great "artery of the West," the Ohio River, and the greatest lake system on the globe, with its fertile soil, its natural resources and its climate a happy medium between the rigors of the north and the enervation of the south, it gave promise of being a tight little commonwealth snugly situated at the heart of things. But those who watched its beginning could have at best only a hazy and symbolic conception of the state as it was to be under the magic wand of progress. We who look back and see what that progress has been with its varied developments undreamed of a century ago have yet more reasons for regarding the founding of a state as a matter of great moment. The realization of this is part and parcel of what may be called a state-consciousness which has been growing in our midst for some years. The sentiment for recognizing this in a concrete way by honoring the place of the state's birth came to the surface as far back as 1913. Corydon was that place; the old stone capitol, still standing there, under the roof of which the transition from territory to state was made, was the very cradle of the commonwealth, and this was the stimulus for a legislative movement looking to the purchase of the building; of which more will be said in its place (p. 29).

IN THE HEART OF THE HILLS

In these days of ever-multiplying automobile tourists the week-end pilgrimage has become a popular form of recreation. An interesting objective with good scenery en route is a sufficient incentive, and of these the State of Indiana, through its Department of Conservation, is offering more and more. This is particularly true of the south part of the state with its flavor of history and its picturesque hill country spreading in scenic variety from the Whitewater to the Wabash. Here, along the lordly Ohio or in the counties contiguous to it, are the old towns, from Brookville to Vincennes, that represent the urban beginnings of our commonwealth, and here the region whence came so many good Hoosier families that are now scattered over the state. Here, too, the state itself had its origin in the little valley town ensconced amid the hills—and that is Corydon.

If the tourist seeking Corydon approaches from the north it is likely he will travel by road No. 31 via Scottsburg, Sellersburg and New Albany. If he does, a short distance beyond Scottsburg he will come to two features that should be of interest to one who is sight-seeing. The first of these is the neighborhood where occurred the Pigeon Roost massacre, noted in our Indiana history as the bloodiest event of the kind in the annals of the state. As a memorial of the tragedy a monument in the form of a tall shaft of stone stands a short distance east of the road and about two miles south of Vienna. The other feature that challenges the attention is the State Forest Reserve, lying just within the bounds of Clark County. This reserve of approximately 5,000 acres, with its extensive tree nurseries as part of the state's conservation and reforestation system, is well worth a passing notice, and if one will take the pains to climb the tall steel tower that tops the highest hill in the reserve he will get one of the most far-reaching views to be had from any point in the state, and one of the most beautiful, especially as he looks southward into the hill country. At this latitude begins that system of peculiar conical hills called the "Knobs," and on the far side of a broad, rolling, heavily-wooded valley that sweeps to the westward the group of these Knobs known as the "Silver Hills" lie limned against the sky in bold silhouettes. Southward of these, at intervals, rise others of the Knobs which the tourist will better note as he continues on toward New Albany. Southward, too, stretches for miles what seems a great rampart, which lies, a broad belt of blue, against the western horizon. This wall and these sentinel hills give one the sense of a mysterious region beyond, thus guarded from intruders, and one of lively imagination may borrow zest from the fact that the object of his quest lies hidden there with the way of access as yet unknown.

As a matter of fact the curious rampart with its odd-looking outlying hills and the intriguing lands beyond, speaking of poetic mysteries, are none the less wonderful when the geologists have explained them. What seems a wall, viewed from a distance, is designated in the books as the "Knobstone Escarpment," being the sharply-descending edge of an upland or plateau, spreading beyond. This upland, composed of soft shales, erodes in its own peculiar ways, thus forming the rounded hills; and as to the mysteries beyond, we find their equivalent when, the rock formations shifting to a decomposable limestone, we come to a land of caverns and subterranean streams.

Road No. 62 leading westward from New Albany to Corydon, a distance of twenty miles, first runs into a pocket of hills, then by a long winding climb mounts the escarpment and enters the upland beyond. Here one finds himself traversing a beautiful, undulating landscape, the salient features being a broad, shallow creek valley bordered by panoramas of picturesque hills and ridges. The road is good and the riding so pleasant that almost before the traveler knows it he is entering the streets of Corydon, a town of something less than 2,000 people, "beautiful for situation" where it nestles low in the meeting valleys of Big and Little Indian creeks, with the surrounding heights looking down upon it. If you climbed the heights so as to also look down you would find the town site to be in a big oval dish up the sloping sides of which the scattering homes mount ambitiously till some are perched on the commanding hill tops. On the lower level the houses snuggle beneath the shelter of umbrageous trees, and there by day and night the hurrying waters of Big and Little Indian croon liquid melodies to them. Very peaceful and rural is the spirit of this Mecca of Hoosierdom in spite of its invasion by the fussy, skurrying automobile, and it seems more impressively so when we remember that it is almost within sight of the three Falls Cities to the east, which collectively make a population center but little short of 400,000 souls. Here for more than a hundred and twenty years it has pursued the even tenor of its way, wholly inconspicuous save for one brief chapter in its history and the renown since reflected by that episode. This was the dozen years between 1813 and 1825, during which period the place was successively the capital of the territory and that of the state, with the added honor of being the scene of the transition from one to the other.

And this brings us finally to the main theme of this booklet—the old capitol building, still existing as a symbol of our political beginnings and as a historical memorial. It stands in its otherwise vacant square in the middle of the town, a plain, two-storied, cube-shaped structure with a hip roof surmounted by a cupola. In its exterior there are few architectural graces, but the whole building speaks of massiveness. The walls are of rough blue limestone, quarried from the neighborhood, the maximum thickness of them being not less than two and a half feet, and the heavy masonry being apparent at the door and window spaces. The house was, obviously, built to withstand the years, and thus far it has done so with no signs of deterioration.

HISTORY AND HEARSAY

Within the last few years curiosity has been stimulated regarding the history of the Corydon capitol and the exact relation of the territory and state to it. Certain traditions about it have been handed down. The date of its construction is usually given as 1811-1812, and its builder as Dennis Pennington, a stone mason, and one of the earliest and best-known citizens of Harrison County. While some say that he was the actual artizan who built it, others state that he was the contractor only. It seems to be generally taken for granted that the building originally erected as a court house was completed by 1813, and that it became the capital at that time. Then there are conflicting statements about various other things relating to Corydon of the capital period, and all in all, one must conclude that along with the bona fide history of the place there is more or less that has been handed down loosely and accepted without verification, as always happens where history of interest has been made.

Since traditions often—perhaps usually—have a valid foundation, the present writer has no desire to take issue with these, but he feels that the first consideration here is to deal with his subject as accurately as may be from the evidence in the case, and to that end he has studied with some diligence whatever he could find bearing upon the matter.

Unfortunately the evidence is incomplete and fragmentary, owing to a culpable negligence that once prevailed in Corydon as elsewhere throughout our state. In Chamberlain's Indiana Gazetteer of 1850, Samuel Merrill, the compiler of the book, speaks of the "laws, records and other papers relating to the early business of the territory" as missing from the state archives, and cites an instance of twenty-seven years before where papers were officially burned up at Corydon because some clerk had complained of being troubled with them. Thus it happens that in the records of Harrison County relating to the old court house there are tantalizing gaps. Fortunately, however, some that were lost have been recovered, and there now exists an interest in their careful preservation by the county officials.

Owing to the dual service rendered by this old building in the past data concerning it are to be sought in two sets of archives—those of the state and those of the county. Those of the state were carefully gone into some years ago by Miss Ethel Cleland, then of the State Library, and as her research gives every evidence of thoroughness I here reprint her findings as they appeared in the Indiana Quarterly Magazine of History for March, 1913.

STATE DOCUMENTS—MISS CLELAND'S RESEARCH

Upon a request for information received by the Legislative Reference Department of the Indiana State Library in regard to the erection of the first State House at Corydon, the bill or bills providing for the purchase of the ground and the erection of the building, and the surrender of the ground to Harrison County, the ensuing investigation was undertaken. After a cursory survey of the subject the question became, to show first whether the State ever owned such ground or building, and if not, who did, and by what right the State occupied them. The sources of information consulted are (1) the territorial acts, (2) the early State laws, (3) the early legislative journals, (4) the limited material in the State Library on the subject.

(1) TERRITORIAL LAWS.—In 1813 Corydon was fixed as the seat of government by "An act to remove the seat

of government from the town of Vincennes to the town of Corydon, in the county of Harrison" (Territorial Laws, 1813, p. 51). This act is entirely silent on the subject of property or quarters to be occupied by the legislature or the judges of the general court. In the laws of the same year (1813, p. 80), an appropriation is made to one Mark Barnett "for rent of two rooms for the use of both houses of legislature during the present session," which, of course, was held in Vincennes, showing that the legislature rented quarters previous to removing to Corydon.

The territorial laws of 1814 contain nothing bearing on this question. In those of 1815 we find (p. 72) an appropriation to Elizabeth Spencer for house rent, but it does not state that it is for the use of the legislature. However, a joint resolution of the same year (p. 117) grants the same person "a further allowance for candles and house rent for the present session." From this it would seem that the legislature rented quarters when the capital was removed to Corydon. Another resolution of 1815 (p. 115) bears so directly on the court house (later called State House) of Corydon that it is quoted in full.

"A resolution for the relief of Dennis Pennington.

"Whereas, it has been represented to this legislature, that Dennis Pennington, who was the undertaker for erecting the Court House in Corydon, in consequence of not receiving the money as contracted to be paid, has been compelled to pay a considerable sum, in interest, etc. And whereas, the Circuit Court for Harrison County do not conceive that they have any power by any existing law to give the said Pennington relief—

Therefore, Be it resolved by the Legislative Council and House of Representatives, That the associate judges for the county of Harrison be, and they are hereby authorized to make the said Pennington any other and further allowance as, from a view of the whole circumstance, shall be considered by them equitable and just, to be paid out of the county funds as in other cases.

"This resolution to take effect from its passage."

(2) EARLY STATE LAWS.—In 1816 the constitutional convention fixed the seat of government at Corydon "until the year 1825, and until removed by law" (Journal of the constitutional convention of 1816, p. 61). In the federal Enabling Act of 1816 four sections of land are granted to the state for the purpose of fixing the seat of government thereon. The legislature in 1820 (laws of 1819-20, p. 18) appointed "commissioners to locate a site for the permanent seat of government." But neither in this act nor in the subsequent act of 1821, 1822, 1823, 1824 and 1825 is there any mention of state property and

buildings in Corydon, or the disposal thereof, except, in a joint resolution of 1824 (laws of 1823-24, p. 113) the state treasurer is authorized to sell such furniture belonging to the state as could not be removed to Indianapolis. There are three other resolutions that seem to have a bearing on the question—one in 1816 (laws of 1816, p. 249) in which the legislature adjourned the Circuit Court from the court house in Harrison County to meet in the seminary in Corydon while the legislature was in session; a similar resolution in 1820 (laws of 1820-21, p. 132), adjourning the Circuit Court to meet in a private house, at the date the legislature convened; while another resolution of the same session (laws of 1820-21, p. 142) authorizes repairs to the "State House" for the next session of the legislature (evidently the building was known indiscriminately as "Court House" and "State House"), these repairs to be paid for from the State treasury.

(3) EARLY LEGISLATIVE JOURNALS.—In the Senate Journal of 1816-17 (p. 22) we find the following:

"Resolved, By the Senate that a select committee to whom was referred an investigation of private engagements to provide a house for the governor etc., etc., be instructed to enquire what is the situation of the right of occupancy of the General Assembly to the Court House of the county of Harrison, and what privileges have been granted by the county court or citizens of said county, and what measures may be necessary to be adopted for the future accommodation of the legislature during the continuance of the seat of government at Corydon, and that the House of Representatives be requested to give similar instructions to their committee with leave to report thereon."

A similar resolution was adopted in the House (House Journal, 1816-17, p. 27), and a joint committee was appointed to investigate the matter (Senate Journal, 1816-17, p. 23, and House Journal 1816-17, p. 27). The report of this committee is found on page 57 of the House Journal of 1816-17 as follows:

"Your committee have made the enquiry into the right of occupancy of the Court House in Corydon for the use of the State, and find that the associate judges of Harrison County, June term, special court 1816, made the following order, to-wit:

" 'Ordered, That the Court House of Harrison County, in the town of Corydon, be tendered to the Territorial and State legislature for the use of the State House so long as Corydon shall remain the seat of government.'

"If the Court House be sufficiently guaranteed to the General Assembly of the State of Indiana by the above

> order, your committee would recommend to the General Assembly to devote the room occupied by the clerk's office in the Court House to the auditor for an office, and that another room in said house be devoted to the Secretary of State for an office, and further we would recommend that the books and papers belonging to the legislative department be deposited in the secretary's office.
>
> "The committee are decidedly of opinion that more substantial assurances ought to be given to the General Assembly by the citizens or court of Harrison County for the use of the Court House for the benefit of the State while the seat of government remains at Corydon."

An interesting agreement was a contract entered into by citizens of Harrison County to furnish a convenient dwelling for the governor, and also, it would appear, to pay certain sums of money for the use of the state. In the treasurer's and auditor's reports of 1816 to 1823 we find receipts for sums of money recovered from sundry citizens of Harrison County.

COUNTY DOCUMENTS

Research in the Harrison County court house discloses additional information, though it is fragmentary.* The earliest document of a consecutive character is the record book of the Court of Common Pleas, covering the period from March, 1809 to February, 1812. This valuable relic of territorial days long ago mysteriously disappeared from the archives but finally was located and recovered. It is filled up largely with the entries of the county business, hence affords a few glimpses bearing upon the antecedents of the court house. The earliest of these is an item under date of March 9, 1809, which reads:

> "Henry [Hervey] Heth and William Henry Harrison came personally into court and acknowledged themselves indebted to the Court of Common Pleas of Harrison County in the sum of five hundred dollars provided the said Heth and Harrison do not on or before June, 1812, convey by a good and sufficient deed to the said court for the use of the said county for public grounds, two lots in the town of Corydon, in said county, containing one acre and four perches each, being heretofore laid off by them for the public ground in said town."

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*To the present court house officials, and particularly to Mr. James Brewster and his sister, Miss Elizabeth Brewster, who have long been connected with the auditor's office, the writer is indebted for assistance in his hunt for source material.

The meaning of this, as pieced out by other existing data, is that the land where the major part of Corydon stands was entered by Harrison. This much is shown by the entry records, the date being July 11, 1807, but before the ground was paid for and the patent given the tract was transferred to Heth, who is credited with being the original proprietor of the town. An advertisement of the first sale of lots may be found in a number of issues of the Vincennes *Sun* for 1808, but the name of the proprietor is not there given. Heth, apparently, as anchorage for the county seat, proffered the two lots mentioned as a court house site and for other public uses, but was unable to give title until the land entered was wholly paid for. Meanwhile Harrison's continued interest in it would seem to be indicated by his appearance as a guarantor of the conveyance to the county, as above shown. As a matter of fact the ground in question was not conveyed to the county till July 28, 1813, when we find by another document that Hervey Heth and Rebecca, his wife "granted, bargained and sold unto Patrick Shield, Moses Boon and Peter McIntosh, judges of the Court of Common Pleas, two certain lots or parcels of land, one acre and four perches each, for one dollar paid in hand;" said land (nw. quarter of section 31, township 3 south, range 4 east) being patented to Heth under date of June 4, 1813. This was the year of the coming of the capital, and whether there was any connection between the two events can only be guessed at.

Nor does it appear just what the facts regarding the court house were at this time. On the one hand it seems hardly likely that the county would erect a permanent building on ground that it did not yet own, and yet the record book already quoted from shows that as early as April 25, 1811, there was a specific movement for such a building in the form of two separate court orders. One of these was to the effect that the Harrison County sheriff should "advertise the letting out the building of a court house in said county, in the town of Corydon," the same to be published one week in the Louisville Gazette. The other "Ordered that Eli Wright, William Branham and Henry Rice be appointed commissioners to employ a workman to build a stone court house in Corydon." Incorporated in these are specific plans which tally closely with those adopted in the structure as afterwards built. At the same time it was provided that the public grounds be cleared off and a little later an order authorizes the payment of fifteen dollars for that work.

This truly looks like the beginning of things, and it is doubtless the basis for the traditional statement that the capitol-to-be was built in 1811-12. Unfortunately for the accuracy of this we find in the same records under date of June 7, 1811, this lone and brief entry:

> Ordered that the order appointing the commissioner to superintend the building a court house in Corydon be rescinded and that said commissioners present their bill to the next county court.

On the same day are other entries, somewhat mystifying at first, but which on close study seem to throw light on the rescinding order. They are as follows:

> A bond from George F. Pope to the judge of the Court of Common Pleas to convey lot No. 12 in Corydon, acknowledged in court.
>
> Ordered that the treasurer of Harrison County pay to George F. Pope [from] the levy of this year three hundred dollars, and that the treasurer of said county pay in the year of 1812, agreeably to law, to said Pope the sum of two hundred dollars out of the treasury of the county.
>
> Henry Rice came into court and undertook to finish the present house purchased from G. F. Pope by the judges for a court house, in a plain, workmanlike manner, and present his bill to the court * * *.
>
> Ordered that the treasurer pay Henry Rice out of this year's levy fifty dollars, to purchase nails, glass, etc., for the court house.

The construction I venture to put upon this is that the court concluded to forego, or at least postpone, the building of a new court house as proposed, instead of which plan it purchased of George F. Pope, for five hundred dollars, in two payments, lot No. 12, and with it an unfinished house, this to be completed and used as a court house. That this was contiguous to the quarters then occupied by the county business is indicated by two other entries, as follows:

> Ordered that William Bradley proceed to extend the roof of the office in Corydon to the court house, * * * and that said Branham [?] lay the floor in the passage between the court house and office, and make steps leading from said office into the court house, and present his bill as allowed.

> Ordered that the treasurer pay Henry Rice one hundred and fifty-five dollars and twenty-five cents in part of his account for completing the court house in Corydon.

This is the last entry referring to the court house in the first record book of the county, and the document shows beyond doubt that the present building was not begun until after 1811. It may even be doubted if it was begun in 1812 in view of the evidence that the county business was established in other, newly-purchased quarters, as above indicated.

It is a matter for keen regret that the second book of county records, covering from early 1812 to the close of the territorial period, is missing. This, undoubtedly, would furnish much data concerning the building of the so-called state house, and there is a suspicion in Corydon that because of this the book has been deliberately purloined some time in the past, along with detached documents, such as bills, receipts and other papers pertaining to this particular construction, now gone but once in the archives.

The next glimpse we get of the court house question is in the county commissioner's records, which began with the state system of government. Here is evidence that the present building was not finished before 1816, for bills of that year from H. Rice, George Jones and William Hunt are for various materials and services, such as "to making two chimney pieces [mantels];" "to running two partitions;" "to weatherboarding for cupola;" "to making and hanging a double door and casing same," and other items including steps to the judges' seat, lumber for inside finishing, two hundred turned banisters and "216 window lights." This looks very much as if the building was then for the first time being made usable, and it seems not improbable that delayed work was being pushed forward for the accommodation of the newly created state. In support of this the state documents already cited show, or at least indicate, that the territorial legislature was renting quarters for its sessions two years after it came to Corydon (p. 14), and in 1815 it passed a resolution for the relief of Dennis Pennington, who had undertaken the erection of the court house and been financially embarrassed because he had not received moneys "as contracted to be paid" (p. 14). Nor is this the only proof that the construction was a slow and intermittent process which was not finished even in 1816, for in the commissioner's records, under date of February 3, 1821, it is "ordered that James Holiday, George Armstrong and William Hamrick be appointed viewers to view the court house in Corydon to judge whether it is done in conformity with bond which has been given by Dennis Pennington and others for the building of said court house, and that the said viewers meet at the court house in Corydon on the second Saturday in April next, and that they report to the best of their opinion the insufficiency in the work, if any there be, and what might be the expense of finishing such court house agreeable to the tenor of said bond." This order is repeated on May 3, and the following August the committee reported that "we are of the opinion that said court house is not done agreeable to the bond given, and that in our judgment the whole expense of finishing said house agreeable to said bond would be forty-seven dollars and fifty cents." Following this rather interesting report is a court order to the effect that "Mr. Pennington and others concerned in said bond are requested to come forward and finish the said court house on or before the November term of this court. If they do not complete the same within the above mentioned time they may depend on being prosecuted on said bond, and that Pennington have a copy of this order." Presumably Mr. Pennington responded to this threat to the satisfaction of the court for there is no further evidence of trouble about the original contract. By way of recapitulation it may be noted that what evidence I have cited shows that the time of construction from start to finish was at least six years, and probably longer, since we do not know the exact date of beginning; while other evidence (see Miss Cleland's findings, (p. 13) indicates that the legislative occupancy of the building began in 1816 and not in the territorial period. On what terms the state took possession of the county's property is not known. The state auditor's reports of that period shown no payments for rent.

To many these things may seem inconsequential and not commensurate with the trouble taken to establish them, but on the other hand, since the interest that attaches to the old Capitol is largely an historical one and loose statements about it have long passed current it is held that here is a proper place to present the question as thoroughly as may be.

THE SHIFTING CAPITAL

The story of Indiana's capital in its relation to Corydon is not complete without a survey of its history elsewhere as well as there.

J. P. Dunn introduces his *Indiana, A Redemption From Slavery,* by reminding us of the various seats of government that at different times exercised jurisdiction over our territory. Says Mr. Dunn:

> Indiana had no capital within her boundaries for one hundred and thirty years after white men had been upon her soil. She was but a part of a province of a province. For ninety years her provincial seat of government vacillated between Quebec, New Orleans and Montreal, with intermediate authority at Ft. Chartres and Detroit, and the ultimate power at Paris. Then her capital was whisked away to London, without the slightest regard to the wishes of her scattered inhabitants, by the treaty of Paris. Sixteen years later it came over the Atlantic to Richmond on the James, by conquest; and after a tarry of five years at that point it shifted to New York City, then the national seat of government, by cession. In 1788 it reached Marietta, Ohio, on its progress toward its final location. In 1800 it came within the limits of the state.

With the formation of Indiana Territory the only logical location for the governing place was Vincennes, the chief settlement then existing in the zone that was opening for settlement, and the most central. Since the first government was a quite primitive one, the governing body consisting simply of the governor and three judges, the question of a capitol building was as yet hardly born, but with the adoption of the second grade, in 1805, there was introduced a territorial house of representatives and a legislative council. Very little has been said about the home of this enlarged body, but to the present day there is in Vincennes a little frame two-storied residence which is preserved as the first territorial capitol. That the territory did not own this is indicated by the fact that at the last legislative session held there an appropriation was made "for rent of two rooms for the use of both houses of legislature during the present session".

In 1809 occurred events which made Vincennes no longer the best place for the capital. This was the setting off of Illinois as a separate territory, and the purchase by Indian treaty of some 3,000,000 acres of land which carried the white man's possession much farther to the north. The next year there was a movement for the selection of a permanent capital site, but for several reasons this was premature and came to nothing. It was not until 1813 that the move was finally made, one reason that probably operated at that time being the war with England and the danger to the town on the Wabash from Indian attacks. Just why Corydon was selected one wonders, since there were other bids for the distinction by towns that were more conveniently located. As late as three months before the removal a memorial was submitted to the legislature praying that Jeffersonville be made the seat, and there is evidence that then and thereafter there was a lively rivalry among the various towns to capture the capital. There are reasons for surmising that Governor Harrison may have been a determining influence, which reasons will be discussed in another place.

The capital remained at Corydon until 1825, or, more accurately, until the latter part of 1824, that length of stay being fixed by the first constitution. Meantime, in 1820, a second attempt was made toward a permanent location, another Indian treaty having secured all the central part of the state, and the federal government having, when admitting the state into the Union, donated four sections of land for a capital site, with the privilege of locating it wherever desired in the country still to be acquired. The spot where Indianapolis now stands, at the center of the state, was chosen; a year later the town for the final capital was founded, and on the expiration of the period fixed for the Corydon occupancy the nomadic seat of government made its last shift. Of this moving two or three first-hand accounts have been handed down to us, and it was a picturesque adventure. An imposing cavalcade of four great four-horse wagons laden with the state's effects and the printing outfit of the state printer took about ten days to travel the 125 miles to Indianapolis.

At Indianapolis history repeated itself in the matter of housing the state's governmental establishment. As at Corydon, there was no state house other than a new court house, and, as at Corydon, again, this was proffered to the state pending the materialization of a real capitol. It was used by the legislature and some of the state offices for eleven years, at the end of which time a $60,000 building erected on the square donated for that purpose was ready to receive them, and the government for the first time owned its own home. This structure was used for about fifty years, when the present one was built.

THE STATE'S BEGINNING

In the long series of migrations just outlined Corydon, of course, is but one of several places claiming recognition as Indiana's capital, but its special distinction is that here the foundations were laid for the state government, and that event is an inseparable part of the town's history. For that reason the story of the state's beginning is in order here.

To get the proper slant on it one must realize that the state-making process is not a sudden and swift accomplishment but a succession of steps leading up to the consummation. The arguments for and against statehood were, on the one hand, a desire for democratic independence and opposition to too much power lodged with a governor who was a federal appointee; and, on the other, a fear of the burden that would be imposed by new responsibilities and increased taxation, which was a perfectly valid fear if the territory were not yet populous enough to carry those burdens. The first movement in the direction of statehood for Indiana was as far back as November 11, 1811, when a petition was presented to Congress asking for admission to the Union. Evidently, however, public sentiment for the change was not quite ripe yet, and the question dragged along with occasional resuscitations until 1815, when an official census was taken to settle the uncertainty as to population. The latter, it was found, exceeded the number required by the Ordinances of 1787 by nearly four thousand, and that effectually cleared the way for further action. During these four years reasons against admission had, of course, been growing less, and on the heels of the census things began to move. Another memorial was submitted to Congress asking for admission and for certain grants for educational and other purposes, including thirty-six square miles as aid to a permanent seat of state government.* This went through the legislative mill with reasonable promptness, and by April 19, 1816, an "enabling" act was passed, conceding with a few modifications what the memorialists had asked for. This was for acceptance or rejection by the territory through delegates whose election was provided for in the Enabling Act, and whose office it was to frame the constitution if statehood were decided upon. These elected delegates—forty-three of them less one who was delayed—representing the thirteen counties then existing, met at Corydon on June 10, 1816, and by a vote of 34 to 8 decided to accept the provisions of the Enabling Act and to proceed forthwith to the framing of a constitution. Then followed the work of shaping the instrument that was to serve as the new state's fundamental law, this occupying them till June 29, and after that there was the transmission of copies of the new constitution to the President and Congress of the United States. Finally there was the formality of admitting the state to the Union by a resolution of Congress to the effect that, the State of Indiana, having fulfilled all the requirements, "is hereby declared to be one of the United States of America, and admitted into the Union on an equal footing with the original states in all respects whatever."

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*Instead of the entire township asked for four square miles were granted.

It may be said that in this instance the making of a state took just one year, beginning with the submitting of the memorial to Congress on December 11, 1815, and finishing with the formal admission by Congress on December 11, 1816.

The Constitutional Convention

We may imagine it was a big occasion for Corydon when the delegates for the constitutional convention came trailing their various ways to the little town among the hills to inaugurate a new departure in governmental affairs. To be sure the place had for three years been the scene of the territorial business, legislative and otherwise, but this new step was something more stirring. The question of statehood was the live issue of the day, over which the prospective state was a-buzz, what with the aroused activities of politicians and the widespread interest of the people in the possibilities ahead of them, particularly in the matter of slavery. This was by no means a settled question as yet, despite the provision against it in the Ordinance governing the country north of the Ohio, and the political partizanship of the day rallied to the anti- and pro-slavery standards. Thus Corydon was in the public eye, so far as that could be in a land of isolated little towns and rural communities where information traveled slowly; and the new stone court house there was the focal point as the forty-three delegates sat there day after day hammering out the foundation on which the state should rest.* If one interested in the process will turn to the Journal of the convention or to Charles Kettleborough's very thorough study, *Constitution Making In Indiana,* he may there trace the growth of the instrument, step by step and find much to stimulate his thinking in certain directions.

It is the general opinion of our historians that the framers did their task well. They were not learned men, eminent in statesmanship; some, even, were illiterate in the modern sense of that word, but they were men of action, of rugged common sense, and acquainted with pioneer needs. At least a few were educated, on the other hand, and, as in the case of Jonathan Jennings, William Hendricks and James Noble, represented a capable leadership. Such is the verdict of history.

CORYDON AS THE STATE CAPITAL

Just to what extent and what way Corydon was affected by its nine years' possession of the state capital cannot be got at directly and clearly. The new situation soon engendered two newspapers—the *Indiana Gazette* and the *Indiana Herald*—but unfortunately they, like all papers of that period, were provokingly lacking in local items, so that any attempt to reconstruct local color is at best a tantalizing process, though indirect glimpses are often furnished by advertisements of various kinds. Even these sources of information in Corydon's case, however, are locally unavailable, barring a little typewritten book of excerpts preserved in the State Library, the only known copies of the publications being carefully treasured in the Library of Congress. The only person known to me who has made a study of these rare files in search of light on early Corydon was the late Charles W. Moores, who as a result contributed a sprightly article on *"Old Corydon"* to the *Indiana Magazine of History* for March, 1917. Mr. Moores' findings and inferences are interesting and I re-present some of them here. For one thing he gathered that there was an oft-recurring fight for the removal of the capital to one or another of the rival towns, one argument for it being that there were insufficient accommodations in Corydon for the visiting law makers and others, and that the boarding house keepers were disposed to profitteer off the situation. Supplementary to this Mr. Moores quotes from his grandfather, Samuel Merrill, compiler of Chamberlain's Gazetteer, to the effect that the town had in 1816 not to exceed a hundred houses, mostly log ones, and that during the legislative sessions there were often large crowds, the provisioning of which was not easy, the nearest source of supplies (Louisville) being twenty-five miles away with bad roads to be negotiated.

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*A colorful tradition that helps out the picture is that the constitution-makers occasionally repaired to the shade of a large elm tree about two squares away where they pursued their labors. Of this elm tree there is more in another place (p. 42).

Apropos, and drawing from another source, Edmund Dana, a traveler who visited the town in 1819 describes it as having "eight or ten neat buildings, besides many others that are ordinary, and a spacious courthouse of stone which is occupied by the legislature during their sessions," and he adds that fixing the temporary seat of government there "has not so much contributed to the prosperity of the town as was expected," one reason assigned being the distance of the site from the Ohio River, which was the great highway of travel. Samuel R. Brown, another traveling visitor, speaks of the great dissatisfaction prevailing in other parts of the state because of the retention of the capital here, and all in all these things must have militated against the growth of the hill town, for the census of 1820 shows that up to that time its population was only 334. It is a fact often cited that the last territorial governor, Thomas Posey, would not make his residence in the town, to the great inconvenience of the territory's business, his excuse being that he was in poor health and could not receive proper medical attention in Corydon.

But if Coydon did not grow physically its character was undoubtedly affected during those years the capital was located there. After 1816, especially, the place must have become cosmopolitan in a small way, what with the general segregation of government officials, annual legislatures and those who came and went because of the state's business. Such men as Jonathan Jennings, William Hendricks, Isaac Blackford, Benjamin Parke, Samuel Merrill and others of that class became indentified with the town in addition to such permanent citizens as John Tipton, Dennis Pennington, Thomas Posey, Jr.,* the Heth's, etc. An aggregation of such men in that day of small, semi-rustic towns, was something unusual, and there are evidences that these introduced into this one sundry elegancies, literary, artistic and social. Miss Angie Leslie, in a fugitive newspaper article (see Harrison County scrapbook in State Library) tells of a Mrs. Jameson whose home was the housing place of a circulating library for the use of members of the legislature and others. These books, says Miss Leslie, were selected with a view to liberal culture, that definition being broad enough to include education in democratic government as well as in Shakespear, Milton, Burns and other classics. Evidently the collection was not very large, for it was kept in a "secretary" or combined desk and bookcase which piece of furniture, the writer tells us, is still preserved in Corydon. The smallness of the library, however, was compensated for by its quality, and the book lovers of the community presumably made the most of their modest wealth, for we are further informed that "their minds were stored with melodious expressions of high thoughts and beautiful imagery," and that "quotations were used quite freely in their speeches." It is gratifying to learn that Mrs. Jameson, who served as librarian and custodian of the books, was appreciated, as appears from the statement that when she became a bride, in 1820, the legislators, of whom Judge Jeremiah Sullivan was one, sent to a Cincinnati silversmith and had a set of table spoons made from silver coins, which token of esteem was presented to her with great ceremony. These spoons, along with other relics of the capital period are still treasured, or were at the time Miss Leslie wrote, by a niece of Mrs. Jameson's living at Georgetown, Harrison County.

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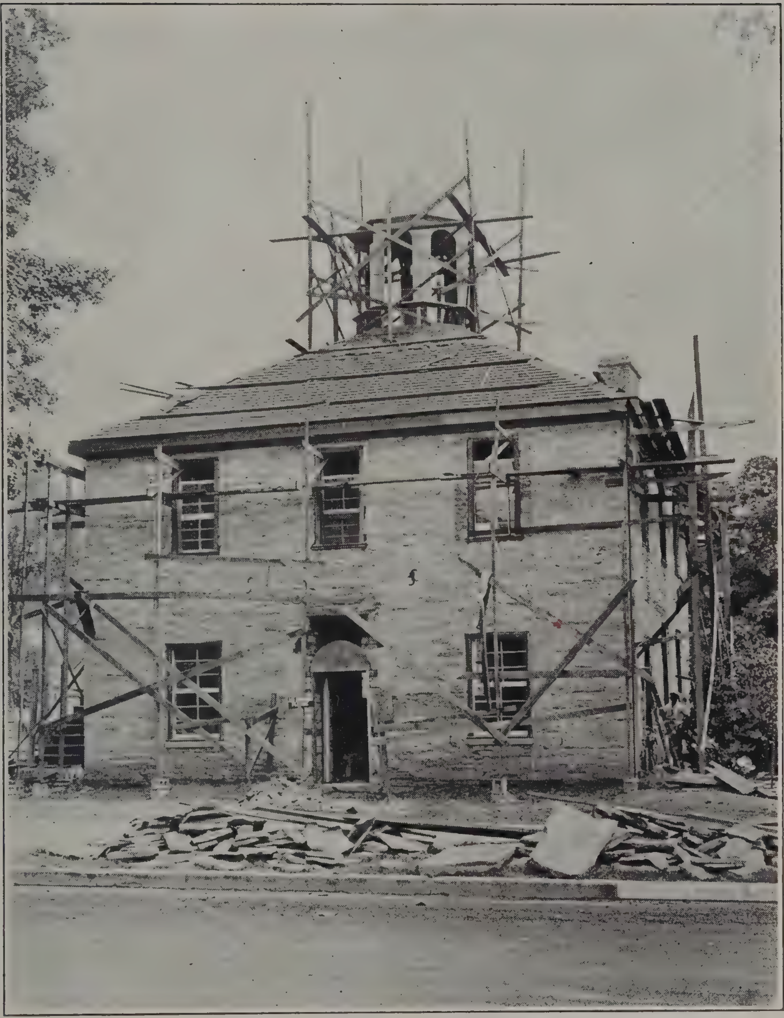
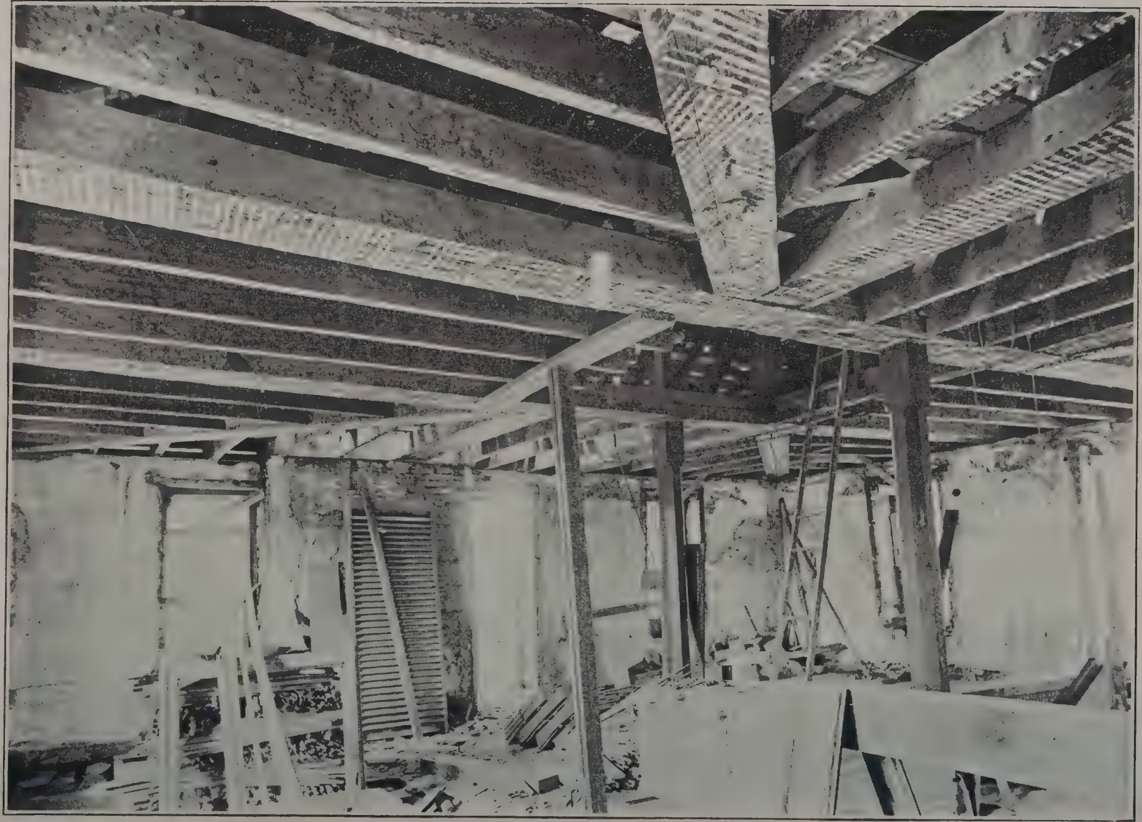
*Some confusion has arisen from statements regarding Thomas Posey, the inference usually being that Governor Posey is meant. There was also a Thomas L. Posey, a resident of Corydon for many years, who was the county treasurer as far back as 1818. The booklet, Historic Corydon, compiled by the Hoosier Elm Chapter of the D. A. R., makes the interesting statement that he was the son of Governor Posey.

Apropos to this interest in books and libraries, we find it existing at the beginning of the state regime, or, indeed, antedating that, for in the journal of the convention is a paragraph in which it is "Resolved, that it be recommended to the general assembly of the State of Indiana to appropriate the money voluntarily given by the citizens of Harrison County to the state, to the purchase of books for a library for the use of the legislature and other officers of government; and that the said general assembly will from time to time make such other appropriations for the increase of said library as they may deem necessary." This may be regarded as the initial step toward our present State Library, though that institution was not established by law until 1825, and if Harrison County sees fit modestly to boast that its early citizens laid the foundation for said valued library by their free contributions of money the documents will bear them out. It may be added that cultural tastes other than literary have left their traces in the retrospect. Not a few relics in the shape of furniture and other household articles, saved from the capital period, may be found in Corydon homes, one of these being a rare product of the cabinet maker's art once owned by Governor Jennings. Some of the old houses of the better class still standing give evidence of architectural taste, and when the state house came to be restored to its original condition—a work just completed—preliminary investigation revealed that the same good taste prevailed in its finishing (p. 31).

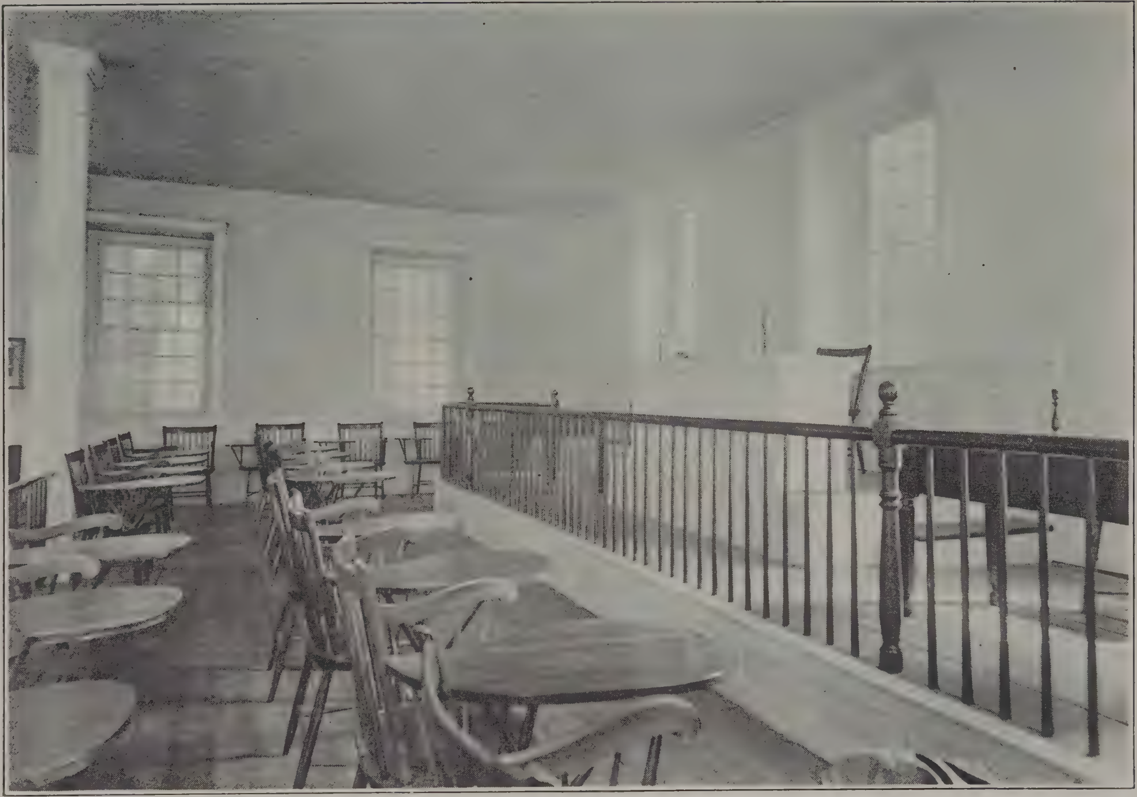
Coming back to Mr. Moores' article, the newspapers show that the serviceable old stone court house and state house was also a community house or social center, where singing schools, debating societies, religious meetings and other functions were made welcome. The character of some of the momentous questions discussed in the debating performances is worth noting, as, for example: "Which is most admired, virtue or beauty?" and, "In which does virtue shine most brilliant, the Male or Female?" Unfortunately the arguments on these points are lost forever. An editorial comment on a religious revival thus speaks of its effects: "It will be peculiarly grateful to the lovers of Christianity to hear of the revival of religion which has taken place in this town. A few weeks ago our streets exhibited little else than intemperance and profanity; but now so far has the scene changed that morality seems to



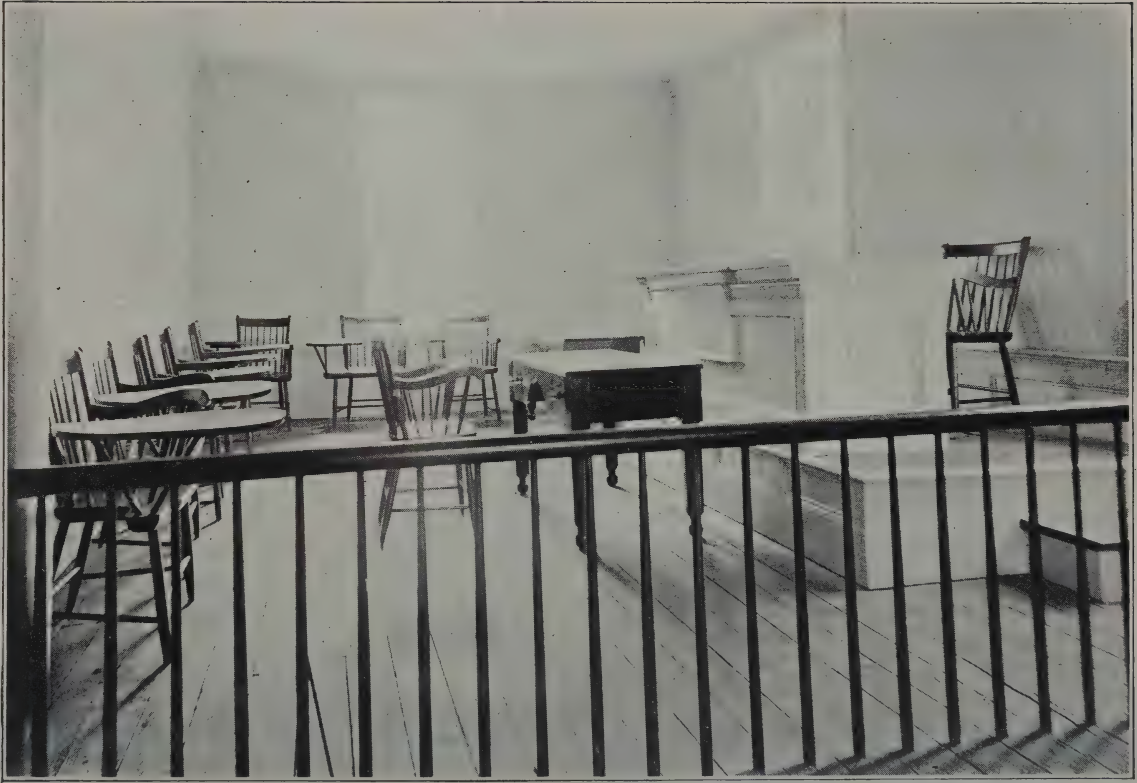
EXTERIOR RECONSTRUCTION OF CAPITOL



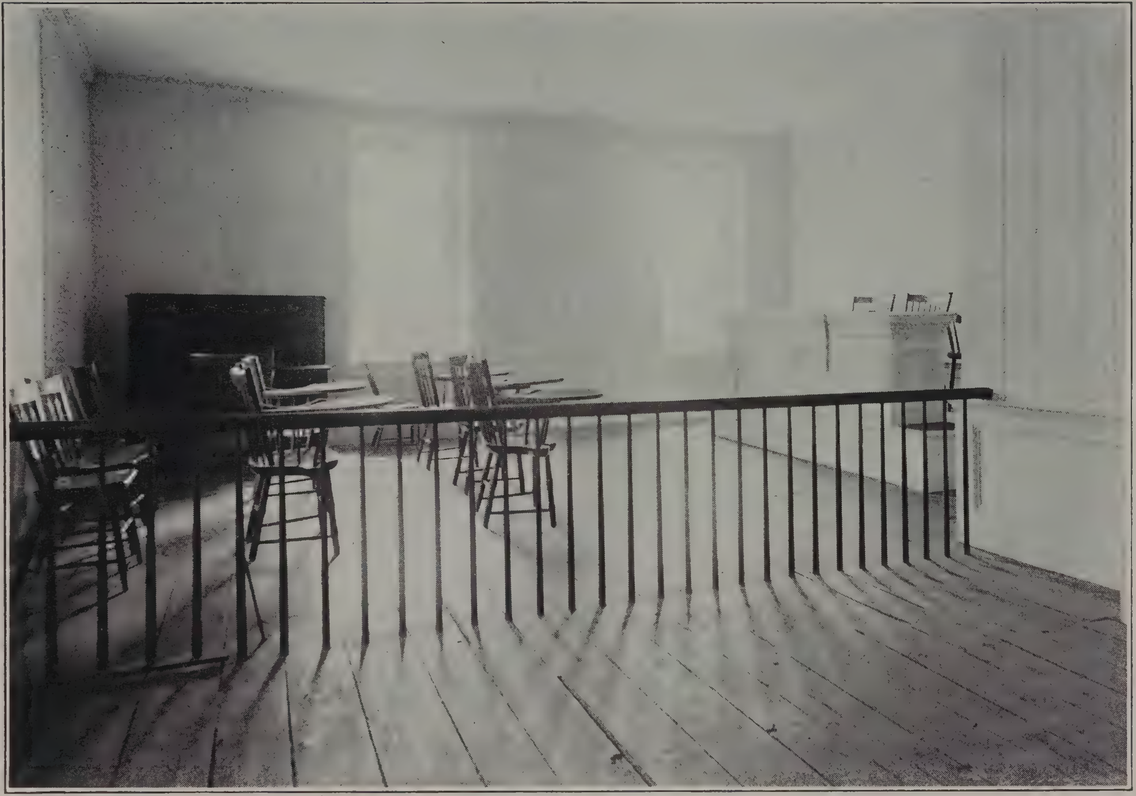
INTERIOR RECONSTRUCTION, SHOWING MASSIVE ORIGINAL TIMBERS



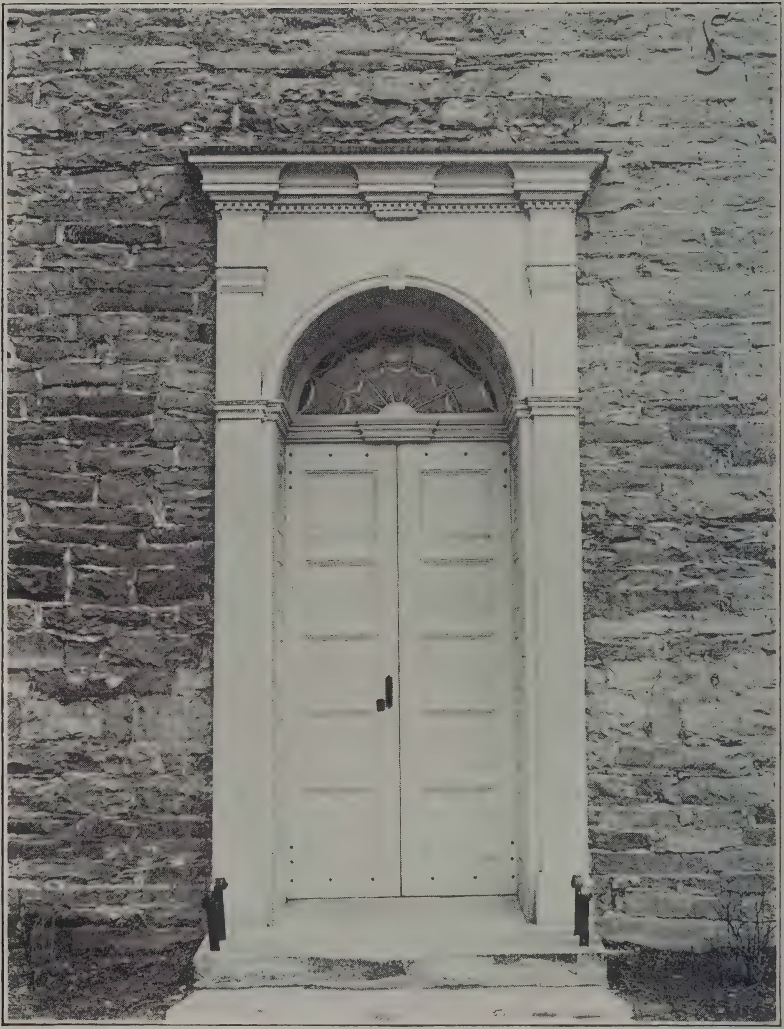
RESTORED HOUSE OF REPRESENTATIVES (LOWER FLOOR)



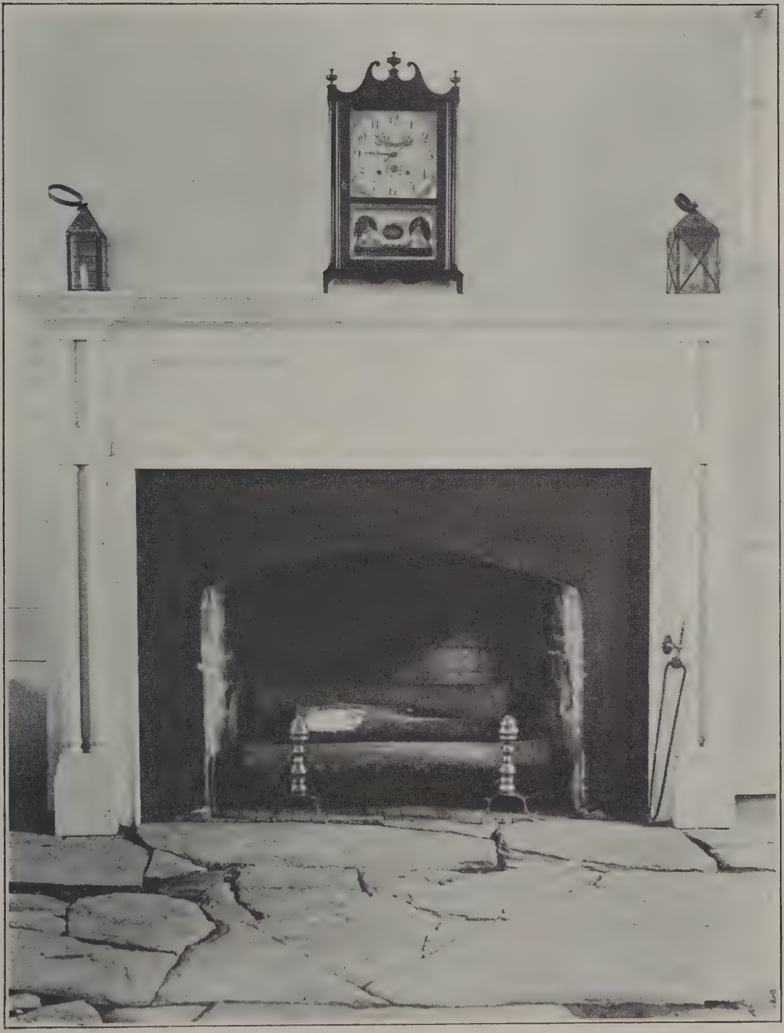
RESTORED SENATE CHAMBER (UPPER FLOOR)



RESTORED SUPREME COURT ROOM (UPPER FLOOR)



RESTORED DOORWAY WITH ORIGINAL TRANSOM



RESTORED FIREPLACE WITH ORIGINAL MANTEL

predominate in every quarter through the day, and at night the sound of prayer and praise, and the shouts of new-born souls cheer the evening shades." Elsewhere these local columns afford glimpses of that ever-popular national diversion, the Fourth of July celebration with its exuberant patriotism, barbecue feasts and interminable toasts, and most memorable of all, of the flying visit, in 1819, of President Monroe and suite, accompanied by General Andrew Jackson, who drove over from Louisville, being met and escorted into town by a liberal contingent of citizens. These distinguished visitors were entertained over night, but a big public banquet that was planned in their honor had to be declined on account of other pressing demands.

ACQUISITION AND RESTORATION OF THE CAPITOL

The foregoing matter is far from satisfactory considered as exact and complete history because of the framentary character of the data, but enough has been said, perhaps, to show why the old Corydon capitol should appeal to the sentimental interest of good and loyal Hoosiers. At any rate such interest does exist, and by reason of it, after the lapse of more than a century, the honored edifice has become what we have here termed a "Hoosier Shrine." So far as the writer can learn the first definite movement to so honor it was in 1913, when Senator E. B. Stotsenburg, of New Albany, asked for the historical investigation that was made by Miss Cleland, and which is printed in this brochure (p. 13), his object being purchase of the building by the state. Whether or not this was a cause to after effects no immediate result is traceable, but in 1817 the question re-emerges in the form of an actual law, passed by the legislature of that year, which reads:

"An act authorizing the purchase of the old state capitol building and the public square in the town of Corydon, Harrison County, Indiana, from Harrison County, Indiana, appropriating funds for said purposes, providing the terms and conditions upon which said old state capitol building and public square may be purchased, and providing for such conditions of said purchase as shall be inserted in the deed from the Board of Commissioners of Harrison County, Indiana, conveying said property to the State of Indiana, and creating a commission to buy said building, and a commission to have charge of the same, providing that said building shall be maintained as a memorial to the pioneers who established the commonwealth of Indiana, and declaring an emergency."

This action is referred to as "a final step in the celebration of Indiana's Centennial."* The purchasing commission stipulated in the act was composed of the Governor, the Secretary of State and the Auditor of State, and the amount appropriated for the transaction was $50,000. One condition was that the county should purchase the block north of the public square and erect thereon a court house, the two holdings to make "one continuous public grounds, thus adding to the beauty and value of said public square and old state capitol building as a public memorial." The county was to be permitted the continued use of the building for four years, free of rent. The commission to have charge of the property after purchase was to be of three members appointed by the Governor, two of them to be residents of Harrison County. At the expiration of the four years allowed the county (1921) the time was extended until 1924, on account of the war preventing the erection of a new court house. The next legislation was an act of 1925, by which the capitol, the Tippecanoe battle ground and the Nancy Hanks Lincoln burial ground are all transferred to the management of the Department of Conservation. The final act leading to the present status is one of 1929, making an additional appropriation of $3,000 "for completing restoration and maintenance of the old state capitol building and grounds to original condition and plans."

The reference in the last quoted law to "restoration" means that the building of 1816 had been subjected to alterations at a later day and the aim now is to preserve it as nearly identical as possible with its features of the capital period. How to determine just what those features were was one of the problems the conservation department had to work out. The principal changes had taken place in 1873, when there was considerable reconstruction. Fortunately specifications for these alterations and other lesser ones at other times are to be

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*An earlier step in that celebration was *The Pageant of Corydon*, written and staged by William Chauncey Langdon as one of three promoted and financed by the state. It was presented in June, 1916, in connection with one of the most stirring patriotic celebrations in the history of Corydon. Governor Ralston and many other dignitaries of the state, including the Centennial Commission, besides crowds of other visitors from far and near, filled the town. There were drills, dances, music and speeches, occupying, in all, two days, and winding up with the pageant, the setting of which was the old Capitol and its immediate surroundings. This performance, appropriately costumed, was historic in its character and represented the conditions, events and personages of a century before. For fuller account see the volume "Indiana Centennial" in the *Indiana Historical Collections*, published by the Historical Commission.

found in the county records, and these, on a close study, carry with them more or less information concerning things as they were. These gleanings, reinforced by the recollections of Judge Wm. Ridley, which antedated 1873, and borne out by the discovery of some of the original interior finishing afforded the foundation for the restoration. The perplexities sometimes consequent upon the scrupulous attempt at historical accuracy is exemplified by the restoration of the cupola. It is known that the first cupola was changed, but there is no clue as to its dimensions and proportions, and the best that could be done was to copy the one on the old court house at Chillicothe, Ohio.

Two lucky finds furnished a clue to the interior detail work and showed that excellent taste was displayed in the finishing work. These were, one of the old mantels and a fan-shaped transom from the original doorway, that were, respectively, in the possession of Miss Georgia Wheat, or Corydon, and Mrs. Elmer O. Shepard, of Brownstown. Both were secured, Mrs. Shepherd generously presenting the transom, and in harmony with them the rest of the finishing was worked out, the whole being in the colonial style. Old doors and hardware were used when available. The hand-made lock on the front door came from the mansion of Governor Jennings, and was presented to the state by Mr. William Mitchell, of Corydon. Carvings and mouldings taken from an old house in Clark County were used in the speaker's rostrum. The rostrum in the senate chamber involves a carved spread eagle and 19 stars. The eagle and 17 stars were taken from a mantel that was built when there were 17 states in the Union, this being an emblem much used at the time. Considerable time was spent in obtaining old glass for the windows. A newel post, stair rail, spindles and trim from an old colonial house in Madison were used in the stairway and railings. The chair rail is a replica of the one in Faneuil Hall, Boston, and of course is colonial. The roof has been given a weathered appearance by using old-style shakes stained with creosote.

The restoration work on the exterior of the building itself has changed it from one of squatty proportions with brick chimneys, large modern windows, wide cornice and mid-Victorian doorway to a stately old structure of excellent proportions and good colonial detail. The difference in proportion has been effected by removing from around the building dirt to the amount of eighteen to twenty-four inches, which had once been filled in. On the inside the work consisted of tearing out all partitions and the door and window frames, along with rostrums of several periods; and of supplying wood partitions, paneling, rostrums, stairway, mantels, fireplaces and other detail to correspond with the outside of the building. Other changes have been the restoration of the judges' seats to their original positions and the making of two floor levels in the lower room, dividing the legislative part from the space for the public, the latter part floored only with stone flagging.

The replacement of furniture and other equipment that would exactly duplicate the first legislative and court outfit was also a difficult task, but after considerable research in that direction and a careful estimate of the governing personnel a selection was made of a sufficient number of old-fashioned chairs of appropriate types, along with such tables, benches and other articles as are fitting. These have been made to order, and to fit the general scheme.

GOVERNOR HARRISON AND THE COUNTY

The direct assertion that Governor William Henry Harrison was a deciding influence in the selection of Corydon for the capital when Vincennes could no longer keep it would hardly be susceptible of proof, and yet there are reasons why one may believe that.

By virtue of his standing as governor and military commander, and his prestige in general he was, undoubtedly, the most influential person in the territory. That he was strongly attracted to this beautiful hill country with its abundant water supply is shown by the fact that as early as 1807, while it was yet an unsettled wilderness, he acquired large tracts of land here, one of which, consisting of 207.26 acres, was the site now occupied by the main part of Corydon. This afterwards, and before the patent was received, seems to have been transferred to Harvey Heth, who is usually referred to as the orinigal proprietor of the town. Elsewhere (p. 16) reference is made to Harrison and Heth in this connection.

Another tract was at the great spring near Blue River, which is still known as the Harrison, or sometimes the Wilson, spring. The entry records in the state auditor's office show that William H. Harrison made here two entries aggregating 360.60 acres, and that Waller Taylor (a Vincennes friend of Harrison's) entered 160 acres; all being in section 19 of township 3 south, range 3 east. Subsequently Harrison must have acquired Taylor's holding, as well as the rest of section 19, for a deed of transfer in the county auditor's office, dated July 26, 1817, conveys from Harrison to Wilson and Bayless, for a consideration of $10,000, two tracts of land, one of 640 acres, more or less (all of section 19), and one of 180.20 acres, "known as the northwest quarter of section 30," of the same township and range. Further proof of his active interest in this part of the country is given in the record book of the Common Pleas Court, where, in reference to an Ohio River ferry "at the mouth of Eight-Mile Creek" the statement is made that said ferry was established "by William Henry Harrison, governor of the Indiana territory, on the 28th day of April, 1807." When the county came to be organized, in 1808, it was named for the governor, and he is credited with having bestowed upon Corydon its odd name, in honor of a favorite song of his, thus perpetuating, as Mr. Moores facetiously suggests, the general's bad taste in music.

The tradition exists that Harrison's preferred route as he journeyed back and forth between Vincennes and the towns at the falls of the Ohio was through this region, which is not improbable, for though the most used line of travel between these two points was an ancient buffalo trace farther to the north, yet a good way was, westward, along the valley of little Indian Creek to its confluence with Big Indian (where Corydon stands), thence northwestward till the path met the above-mentioned "trace." As a matter of fact the county records show that at quite an early date roads were opened along this route, touching Corydon and "Harrison's mill," of which latter there are several mentions.

Harrison's activities in his namesake county went farther than the mere acquiring of lands. The section 19 above mentioned, lying on both sides of the Great Blue River, was a choice spot scenically, and had on it a remarkable natural feature in the form of a great up-welling body of water, now commonly referred to as "Wilson's Spring" (from a subsequent owner), which furnished excellent water power for a mill (see p. 36). At this picturesque spot Harrison built both a water mill and a residence. Just when he built, or just when he lived there is not clear. Professor Collett, the geologist, says explicitly that the mill dated from 1805-6, but the error of this is obvious when we remember that the land was not entered until 1807. That it did date back to 1809, however, is shown by the record book, which specifically mentions it at that date and several times thereafter. As has already been said, the property was sold to Wilson and Bayless in 1817, after which Harrison ceased to be a resident of Indiana.

Traditions of the Harrison occupancy linger about this spot. Collett, writing more than fifty years ago, says: "Every locality and plot of land calls up some historic reminiscence of its original owner. One plot is known as the 'governor's field,' another as the 'general's meadow.' * * * Persons now living in the vicinity remember, when boys, being sent to mill on horseback with a sack of corn or wheat which General Harrison would receive with his own hands and carry to the hopper." And he adds: "The old residence is gone; some shrubbery remains, and the orchard planted by the American Cincinnatus survives in vigorous growth and fruitage, the trees, now from two to two and a half feet in diameter."

J. Edward Murr, writing in the *Corydon Democrat* for March 14, 1923, reports an interview he had once gleaned from an elderly resident, "Aunt Barbara Foster," which confirms Collett, and the present writer, when visiting the locality in question some thirty-five years ago, picked up similar stories. The orchard trees (apples) referred to by Collett were still standing to the number of five or six, three of them green and bearing fruit. The spot where the old house had stood, which could still be identified, was beautiful for location, being situated on a rise of ground in the heart of a fine meadow. Almost surrounding it, and at a distance, a magnificent amphitheatre of wooded hills sweeps upward and away to the purple distance, and here in the seclusion, the deep quiet and the beauty of wild nature Indiana's first governor doubtless found occasional and welcome surcease from the activities of a strenuous life.

COUNTY FEATURES

THE "KNOBS."—In the Indiana geological report for 1878 there is a survey of Harrison County by Prof. John Collett, then assistant state geologist, which is, perhaps, the best existing account of the natural features of that locality. As Prof. Collett's descriptions are from first-hand studies we can not do better than to draw freely upon them for this topic.

The geology of the region is a key to the peculiarities that are obvious to the casual observer. In the 478 square miles that comprise the county not less than five groups of rock formations come cropping up, two of which may be considered specifically as productive of distinctive features. These are the knobstone shales and the limestone of the cave country. The former has already been mentioned in our introduction to the knobstone belt of hills and upland which occupies the eastern edge of the county. The name is derived from the conical or knob-like character of its hills which, together with their causes, are thus described by Collett: "The pyritous nature of the shale causes rapid decomposition on exposure. The result is a fine plastic clay which at once yields to the action of water, almost of moisture; hence, whenever exposed, the surface of the country underlaid by rocks of this age presents a wonderful succession of sharp, conical knobs, from ten to four hundred feet in height, of singular beauty and symmetry. As seen from a commanding eminence, when covered with grass, they look like the tents of an army of silent giants." Where these hills meet the Ohio River valley their lofty tops command a magnificence of view which Bayard Taylor, the famous traveler, pronounced one of the most interesting he had ever seen, what with the broad sweep of the river's great trough, the three cities clustered together at the rapids miles away, and the far Kentucky hills to the east and south etched against the horizon. One of these knob summits, "Locust Point," 610 feet above the waters of the river, represents in its sheer rise the greatest immediate relief to be found in the topography of Indiana, though it is not the highest point above sea level.

The survey just described is rivaled by other fine views from hilltops west of the knob group. One of these is at the extreme southern point of the county where, from an altitude of four hundred feet or more, the eye commands the river as it describes a vast semicircle, forming the boundaries of the whole southern half of the county, while in the distant hill ranges the sugar-loaf knobs stand out sharp and distinct.

Again, from Pilot Knob and other heights in the vicinity of Corydon may be had a bird's-eye view of much of the county from its center. Here, looking to north and south, can be seen evidences of a great valley washed out by pre-glacial floods, miles wide, and eaten into by the minor valleys of Big and Little Indian creeks. From here, too, the Knobs are part of the scenery, the system extending from the southeast diagonally into Washington County, on the north.

THE CAVE COUNTRY.—Underlying the "extinct" valley spoken of, and extending westward lies the cavernous limestone, out of which nature has created a world of strange phenomena. The technical explanations of this by succeeding geologists are more or less confusing to the layman, partly by reason of changing terminology, so for the sake of clarity we may adhere to Collett. The phenomena referred to are those of subterranean drainage and its allied caves with their various peculiarities. The general cause leading to these effects is in the character of this particular limestone, which decomposes under the action of rainwater, thus adding a chemical agency to the ordinary mechanical agency of erosion. Thus the bedrock becomes honeycombed by the waters that find their way through joints and laminæ, chemistry opening the way and aiding erosion. In this destructive process, which is carried on at the surface as well as below it, there is a residuum of various rocky forms which are more resistant, and where these are sufficiently accumulated they make a surface of fragments through which the water percolates to hidden depths, so that it is no unusual thing to see a stream suddenly and mysteriously disappear from its visible bed to reappear at some other point. Sometimes it may enter a tunnel of its own making, in which case it simply duplicates the performance of the famous Lost River in Orange County. Big Indian Creek itself, according to report, in dry weather loses itself a short distance below Pilot Knob and continues its way under cover for several miles.

The sometimes curious and interesting emergence of these streams in the form of so-called springs calls for specific mention. The big Harrison or Wilson Spring already mentioned is fed from two or three depressed areas in the northwest part of the county that would be lake basins but for the filtering away of the rainfalls through a porous surface and by way of an underground passage that terminates at the Harrison place. Here the waters suddenly reappear, boiling up into a great circular basin whence it flows away to Blue River near by in a stream large enough for mill power, for which purpose it was for many years by Harrison and his successors. A still more spectacular uprising from the nether regions is the spring known as the "Blue Spouter," near Blue River, some three miles below the Harrison Spring. According to Collett's description this, when the water supply is abundant, gushes out "with a roaring violence, sometimes spouting up four or five feet above the basin in a column four or five feet in diameter, silvered with foam, and carrying out the fish peculiar to the open streams of that region, indicating a connection with some of them at no great distance." Other smaller and less impressive emissions of the character described are common in the county, two being within the limits of Corydon—one at the fair grounds and one near the site of the big elm tree of constitution fame.

The conical, pit-like sinkholes constitute another feature of the cave-stone country, and these are numerous in Harrison County. Sometimes they hold water and make convenient little drinking ponds for live stock,* but in general they serve as funnel-like feeders to subterranean passages, and may be called a surface attack in that age-long process which works incessantly to break down and bodily remove what seems to be the foundations of the earth.

But the most impressive phenomena of the cave country are the caves themselves, those mysterious crypts of Pluto, curiously fashioned, weirdly ornamented, and the abodes of strange creatures that dwell in utter darkness. Few natural wonders stir the imagination as does a cavern of the larger sort with its galleries and chambers and devious passages; with its stalactites and stalagmites, now grotesque, now of fairy-like beauty; with its crystallizations and formations of snowy gypsum. Just how many caves there might be in any region of underground streams it would be impossible to say, since not all of them have openings that lead to discovery. Harrison County, lying at one edge of the cave belt, has a half-dozen or more that are of interest. The most accessible of these is King's Cave, about four miles east of Corydon and near the New Albany road. It has been explored for three or four miles; its largest chamber is said to be 120 by 16 feet, and it has the customary stalactite formations, besides a little lake containing blind fish and crustaceans.

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*One of these near the village of Palmyra, in the north part of the county, has been dignified by the name "Lake Palmyra." Its area is given by Collett as twelve to fifteen acres.

WYANDOTTE CAVE.—The sojourner in this region, however, who wishes to see cave phenomena in their most striking forms will drive some ten miles westward from Corydon to the famous Wyandotte cavern which lies just across the line in Crawford County. Incidentally, the road leading thither connects also, by a slight divergence, with the old Harrison place and spring.

Wyandotte Cave is, in the opinion of many, the most remarkable natural feature of Indiana, being in magnitude and in its aggregation of wonders comparable to the more widely advertised Mammoth Cave, of Kentucky. Though it has repeatedly been described it is by no means so well-known as it should be, and an account of it here is in order since it comes within the tourist zone of Corydon and its vicinity and comprises within itself all the cave features on a large scale.

The ride from Corydon, now made easy by auto, is itself worth while. The last four miles of the way runs along the narrow, winding valley of Blue River with the wildness of nature lying all about. Below the traveler, as he skirts the hillsides, the purling river glistens and murmurs, and through leafy vistas appear ever-shifting glimpses of verdure-laden heights and blue distance. Halfway down the route by the deep-cut valley lies the village of White Cloud nestled within the hollow of a mighty, semi-circular wall of rock that marks a bend of the river—a wall that to the eye seems almost verticle, yet is clothed with timber and thickets intermingled with smaller flora and rich mosses spreading as garments over the seamed and weathered rocks that in places look like ancient ruins. The wild and picturesque scenery continues all the way to the cave, the final stretch being a long up-hill climb to an airy eminence where stands the cave hotel looking over a magnificent prospect.

It is not intended here to specifically describe the numerous features of Wyandotte Cave, but merely to convey an idea of its general character. That character throughout is dramatically impressive. The entrance to it, a great black hole in a forested hillside, looks like a huge gaping mouth, the upper lip represented by an overhanging ledge of rock, and when one approaches and becomes sensible of a soft outward flow of air the suggestion of a breathing monster inspires a feeling of awe. And to one of sensitive imagination this feeling deepens when he enters that dragon's throat and descends by a sharply declining path, down towards the pits of eternal night. For a space the day seeks to keep him company, its penetrating light streaming athwart the rocky sides of the passage, dying away to gray streakings that grow fainter and fainter till swallowed wholly by an inky blackness that is only accentuated by the dim lantern of the guide. Not less uncanny is the vast and unnatural silence that reigns here, coequal with the darkness. The cheerful world with its familiar sights and sounds is left behind, and here is a realm for gnomes and kobolds and all the wierd creatures about which has played the fancy of man from time immemorial. Or, to those who do not indulge in such fancies, it may be said that hardly less strange is the real cave population as revealed to the matter-of-fact naturalist, what with fishes and crayfishes, crickets, centipedes, spiders and others of their ilk, all colorless, all blind and all with instincts developed by their environment.

Wyandotte Cave has three main branches, which, uniting, find a common outlet, and the combined length of which, it has been stated, are about twenty-three miles, though estimates vary. The influences that have operated in the cave at different periods have produced a variety of phenomena. First, we may consider the action of the water as an erosive force. As we enter those Cimmerian vaults and, by the feeble gleaming of lanterns and candles get some idea of their dimensions, we are filled with wonder at the power that could thus invade the living rock and hollow out vast chambers there. In many places the action of the strong floods can be clearly traced by the rounded surfaces and the smooth grooves plowed along the walls. Not the least of the fantastic results of this resistless blind force are the ever-varying forms and dimensions of these cavernous spaces. Now we walk through low, broad passages where for a stretch we may reach up and touch the rock ceiling; or, again, we must crawl upon all fours—the spectacle of men and women thus making their slow way in a procession through the dimly revealed surroundings suggesting some grotesque, mysterious rite. Again, we tread stately corridors or thread winding tunnels, and anon emerge into some vast room which dwarfs all interiors made by the hand of men. The greatest of these, known as "Rothrock Cathedral", is a vaulted chamber so spacious that "Monument Mountain", an immense hill of broken rock that once fell from the roof, making a pile one hundred and seventy-five feet in height, has at least fifty feet of clear space above its summit. Not until the guide, as is his wont, sets aflame a brilliant colored light do we get an idea of the dim immensity of this colossal exhibit.

The stalactite and stalagmite formations with their variants are impressive in a different way. Here we have the grotesque, there the delicately beautiful. Upon the overhanging ledges and where the walls lean inward, presenting oblique surfaces, the mineral deposits run together in curious, fantastic combinations, sometimes in marvelous imitations of rich, heavy fringings and drapery, as if nature with cunning hand had consciously decorated her palace in emulation of art. Another striking form is the union of stalactite and stalagmite into what seems supporting columns, the most remarkable example of this variant being the famous "Piller of the Constitution," an elaborately fluted and ornamented shaft, not less than twenty-five feet in diameter and thirty feet high, that connects floor and ceiling. Another kind of formation which adds to the ornamentation of the cave is deposits of gypsum which in places encrust the interior with dazzling white crystals that reflect the candle rays from a million facets. All the fantastic creations of the frost king are reproduced in what seems a covering of purest snow, while delicate wreaths and rosettes of the same white substance adds to the decoration.

Unfortunately we find in Wyandotte Cave repeated evidences of the ubiquitous vandal who does not scruple to multilate the wonders of nature to gratify a filching instinct, or, what is equally culpable, to mar them by scribbling names over them. Sermons against this pitiable human weakness can not be preached too often or too vigorously.

MARENGO CAVE.—While speaking of the natural wonders of this region at least a few words should be said about Marengo Cave, which lies a few miles to the north of Wyandotte. In its wealth of curious formations it is generally regarded as the most beautiful of Indiana caverns, though in the magnitude of its erosions it does not compare with Wyandotte. State geologist Blatchley gives its total length as 3,850 feet only, but says that "within this distance of less than three-fourths of a mile are probably crowded more beautiful formation of crystalline limestone than in any other known cave of similar size in the United States." The attempt to suggest the character of its features by appropriate nomenclature has given rise to such names as the "Fairy Palace," the "Pillared Palace," the "Crystal Palace," etc. The last-named Blatchley affirms to be the "Crowning glory of Marengo Cave," and thus describes it: "It is a small alcove or side room, ninety feet long, fifteen feet wide and about twenty-five in height. At the south end is a perpendicular wall along which is a drapery or vast sheet of stalactites, and from a projecting shelf are many slender stalagmites, the whole so grouped as to resemble a giant pipe organ. The side walls are studded with hundreds of small and large formations, while from the roof hang pendant myriads of slender stalactites of the clearest crystal, which reflect with sparkling brilliancy the rays of the calcium or magnesium flash lights." The "Pillared Palace" is so called because of "giant pillars, stalactites and stalagmites so numerous that it is with difficulty the visitor winds his way between and around them." Other features that made the place well worth a visit might be mentioned, among them a great hall-like cavity, with remarkable acoustic properties, and a natural platform of rock at one side. Some twenty or more years ago an enterprising promoter agitated the plan of lighting this chamber with electricity and utilizing it as an auditorium for Chautauquain meetings—a proposition so intriguing in its novelty that it is a wonder some one has never carried it out.

NOTE—Accounts of Wyandotte and Marengo Caves and their fauna, with illustrations may be found in Collet's geological report of 1878 and Blatchleys report of 1896.

SUPPLEMENTARY MATTER

THE CONSTITUTION ELM

The most famous tree that ever stood in Indiana was the "Constitution Elm," at Corydon, only a dead frament of which now remains. It was a magnificent specimen of its kind, which presented when in full leaf, a vast rounded crown one hundred and thirteen feet across in one diameter and ninety-seven in the other. Its trunk four feet from the ground was about thirteen feet in circumference. The age of the tree was not known, but a tradition that has been handed down is that as long ago as 1816 it cast over the green grass a shade so broad and inviting that when, in the month of June of that year, the delegates were engaged in framing the state constitution they held their meetings on hot days beneath this elm. Several old residents of Harrison County, now dead, whose memories went back to 1816, were authority for this. One of these, a Mr. Wynn, stated that as a lad ten years old he took early apples from his home to the out-of-door meeting-place and peddled them among the delegates; and among the earliest recollections of Henry Funk was a picture of the gathering of the men in their shirt sleeves sitting around under the great tree. For these rescued reminiscences we are indebted to Mr. J. Edward Murr, a locally well-known contributor to the *Corydon Democrat*. Mr. Thomas James de la Hunt, a newspaper man of Evansville, also tells of the stories which, as a child, he used to hear from his grandmother. This grandmother, in 1816, was a little girl, Becky Lang, who with other children was wont to play under the big elm, and her special reason for remembering the convention was that the meetings under the tree took their playground.

Interviewing Mr. Frank Wallace, the state entomologist, with reference to the cause of the elm's destruction I was told that some years ago southwestern Indiana became infested with a root fungus that was especially fatal to elm trees. Corydon was particularly rich in elms, and several fine specimens fell victims to the disease. Then the father of them all was attacked and the deadly fungus carried on its ravages under-ground till it was too late for any remedy. The tree gave visible notice of its approaching end, and the last year of its leafage, with its vast spread of foliage shrivelled and of unhealthy hue, it seemed to be making a pathetic struggle for life as it died inch by inch. Its loss was regarded by the Corydon citizens as little short of a tragic event, and to delay its utter disappearance as long as possible it was shorn of its great limbs and their stumps made to support a sheltering roof to protect the dead trunk as well as could be. Out of the removed boughs many souvenir relics were made, and in a few years more these will be the only tangible reminders of the glorious old historic tree. To the "Hoosier Elm Chapter" of the D. A. R. belongs the credit of a special allegiance to the sylvan monarch. Several years ago they erected at its foot a marker with a bronze tablet bearing this inscription: "On this site, June 10-29, 1816, the Constitution of Indiana was framed." When disease assailed the tree they did what they could to save it by tree surgery and by spraying, but this, it seems, was not the right remedy.

The name of the fungous foe above cited is given as "*Phymatotrichum omnivorum.*" If post mortem levity is permissible it may be added that no wonder the tree died.

THE "BATTLE OF CORYDON"

Corydon can lay claim to being the scene of the only battle of the Civil War that was fought north of the Ohio River. The date was July 9, 1863, a few days after the great battle of Gettysburg, also fought north of the Mason and Dixon line; the enemy engaged was the little army of that dashing cavalier, John Morgan, whose audacious invasion of Indiana put the whole state in a panic. Some two thousand five hundred strong, all mounted and equipped for swift adventure, they came sweeping up from Kentucky, and the first that Harrison County knew of their approach was when they arrived at Brandenburg, on the south side of the river, and prepared to cross there. Thus this county on the north side was the first point of attack, and, in view of the steps taken to resist the raiders, the story of the incursion finds here its greatest interest. The hostile incursion as a whole has been written of repeatedly, but reminicences local to this county that are to be found in the files of the *Corydon Democrat,* and which are preserved in a Harrison County scrapbook in the State Library, give an intimate flavor not to be found in the more formal narratives.

According to articles by Samuel Pfrimmer and J. Edward Murr the advent of Morgan's force on Hoosier soil set the local Paul Reveres a-skurrying far and wide to arouse the country-side. Farmers left their harvest fields, merchants their stores, and all rallied to the defense. Morgan spent the 8th crossing the river, using two steamboats he had captured. Attempts were made to prevent him, but after a brief artillery duel the defenders were driven back and the crossing effected. That night the Confederates encamped on Indiana soil, and the next day took up their march toward Corydon, where the home guard was gathering to stop them. Pfrimmer says the defenders numbered about 500. The first actual violence committed by the invaders seems to have been at the home of Peter Glenn some distance south of the town. Here, for some reason, Glenn was killed, his son wounded and his buildings burned. About a mile south of town a line of defense had been established, protected by a breastwork of logs and rails. Here there was a brisk little fight, raw militia against veterans, which lasted until the raiders flanked both wings of the opposing force and destroyed its morale by the use of two or three cannon which were part of Morgan's material Then the volunteers were ordered to retreat down hill into the town, which they proceeded to do in orderly fashion at first, but more shells screaming over their heads accelerated their speed, which became a general scramble when a second rail barricade at the foot of the hill obstructed the retreat. In view of their inferiority of numbers, poor arms and utter lack of training and war experience perhaps the minute men did not do so badly. At any rate they put up a fight that resulted in the killing of several men on each side, and the wounding of more.

Murr says that Morgan's command came into Corydon from the north, south, east and west, and that the defeated home guard surrendered to them. The comissary department for the Corydon army, he adds, was under the supervision of David Jordan, who had assembled great quantities of bread, cake, pies and meat, but instead of serving these viands to the patriots, as anticipated, the "Johnnies" deposed him from high office of quartermaster and he was put to drawing a water supply from a well while the intruders took charge of the eatables. Morgan, says the writer, levied $1,000 on each of the flour mills in town as the price of protection. When one man gave him a roll of greenbacks and it proved to be $1,200, two hundred were handed back with the query: "Do you think I would be guilty of cheating a man?"

The Confederates kept possession of the town till late that afternoon, then marched onward toward Salem. During their stay they looted some of the stores, appropriating whatever struck their fancies, and some of the soldiers rode about the streets wearing women's bonnets which they decorated to their tastes with gay ribbons. On the whole, however, the exciting adventure turned out so much better than the fear-stricken inhabitants had anticipated, and Morgan's part in it was so tinctured with unexpected humanity that the unwelcome visitors were afterward regarded with considerable leniency. After the war, we are told, Colonel Bennett and others of Morgan's men came to Corydon to place a suitable marker at the graves of their comrades who were slain there. Colonel Bennett made an address on the occasion, and it may be presumed that all animosities were then and there smoothed over, though that did not interfere with the claims of an astonishing number of men, each of whom maintained that he had shot his rebel at the "Battle of Corydon."

BOONE'S MILL AND CAVE

A feature of historic interest that has from time to time furnished picturesque material for newspapers articles is what is known as Boone's mill and cave, located near Buck Creek, in the south part of Harrison County. So far as I know, the first and most authentic account of these two objects is that written by Prof. John Collett, which may be found in the Indiana Geological report of 1878, and which is here reprinted. Collett says:

* * * On one of his hunting expeditions Squier Boone, brother of the famous Daniel Boone, of Kentucky history, in passing along the eastern bluff of Buck Creek, noticed a small cave-like opening in the rocks, partially hidden by bushes. It appeared to be a good hiding-place for large wild game. A few miles further on he was attacked by three Indians; his only chance for life was to fly. The pursuit was immediate and earnest and it was evident that they would soon overtake him. He remembered the hiding-place discovered a few hours before and reached it when his pursuers were less than a hundred yards behind him. Throwing himself into the cave, he heard the Indians pass over his head. The little cavern had saved his life. To him it was

holy ground, and he selected it as his final resting place—a sepulcher carved out by the hand of nature. He desired that after his death his body should be entombed there."

Collett visited this spot and found the entrance to the cave to be a small opening into the side of a hill, which had been covered by a rough, flat stone. This latter removed, the way led downward to a little room about six by eight feet by five feet high. This was Boone's tomb, and here the exposed bones of the pioneer were found, though the coffin had been broken and the vandals had taken their toll, the skull being gone.

Squier Boone settled in this vicinity and spent his last days here. Near the "grave cave" spoken of is another one from which pours a stream of water strong enough to supply water power, and here, says Collett "Boone built a mill, preparing the materials almost wholly with his own hands. The building was of stone. Many of the blocks were ornamented with figures and emblems, displaying some degree of artistic skill, and all by the hand of the old hunter. A trailing vine in full leaf and laden with fruit was cut upon the lintels, and figures of deer, fishes, a horse, a cow, a lion, a human face and stars, and many texts from the Bible were sketched upon the stone in different parts of the building. Over the doorway was this inscription:

"The-Travellers-Rest-Consecrated
By-Squier-Boone-1809"

Over another door is the following:

"I-Set-And-Sing-My-Souls-Salvation-

And-Bless-The-God-Of-My-Creation."

From recent inquiry it would seem that the last vestiges of these interesting relics of Boone that existed half a century ago have now disappeared, by the hands of the relic-purloiners, presumably. Whether the bones of Boone suffered the same fate none seems to know.

THE OLD "CAPITOL HOTEL"

For many years and until 1921 there stood a mile or so east of Corydon, on the New Albany road, a house that shared with the old Capitol the honor of association with the state's beginning. This was a venerable residence building, constructed, like the Capitol, very massively and of rough limestone. It took its name, "Capitol Hotel," from the tradition that it was the boarding place of the visiting delegates to the convention that framed the constitution, but this, like some other traditional stories had its rather insecure foundation in the lively imagination of newspaper writers. As a matter of fact, in 1816 there were also other hostelries in Corydon, and this one a mile away probably took the overflow from the more convenient ones. Aside from this question, however, the building in its own right was worthy of note and remembrance. It was a rare specimen of pioneer architecture, and its destruction by fire, in March 20, 1921, is much to be regretted. Citizens of Corydon sought to secure what was left of it, to restore and preserve it, but the owner of it seemed to have very little sentiment in that direction, and the ruins were supplanted by another house. When I first visited the place. many years ago, I made notes from which the following description was written:

"A mile east of Corydon I came to a house so picturesque and curious in appearance that I turned up the lane leading to it. I found it a relic (then unoccupied) of other days. It was built of large blocks of limestone, the massive walls, more than a foot thick, still being solid as a fort. A luxuriant trumpet vine clambered over the front, ornamenting it with clusters of long pods, and half concealing the little deep-set windows, while all over the decaying varanda a great grape vine had spread itself. Inside the quaint little rooms, with their hand-beaded joists overhead and cavernous, many-shelved cupboards, the yellow poplar woodwork was still sound. In every room was a fireplace, and in the kitchen a huge one, such as pioneer chronicles tell us of, not less than seven feet wide, shoulder high, and spanned by an old-fashioned mantelpiece almost out of reach. At the rear of the house, flowing a stream as thick as one's arm or larger, a crystal spring issued from the edge of the hill and down a groove that it had cut across a leaf of solid rock. A dismantled log stable hard by added to the antiquity of the spot, and was especially interesting as evidencing pioneer skill with the ax. The notches and saddles chopped out at the ends of the logs fit together like joinery work, the ax had finished every log with precision and neatness, and even the hinges on which the doors hung had been fashioned by the same tool."

It is safe to say that this dwelling was as old if not older than the capitol, and it bore evidence of being the handiwork of the same builder. I believe mention of it as the Conrad tavern appears in the county's first book of records.

THE FIRST STATE MAP

The map opposite page 7, made by a Scotch cartographer, John Melish, in 1817, was the first one of Indiana after its admission as a State, and so comes nearest representing the political division at the time of admission. On the map are five more counties than were represented in the constitutional convention, these being all created by the first state legislature, which convened in December of 1816.

This map is distinguished by a conspicuous error in the placing of Lake Michigan.

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Using Our Abandoned Farms

By

RICHARD LIEBER
Director, Indiana Department
of Conservation

Reprint from National Republic Vol. XVIII., No. 1
Washington, D. C., May, 1930

"The nation would rise in defense of an acre taken by a foreign enemy, yet forest and soil have been wasted, robbed of fertility, burned and pillaged by the American public itself." A Morgan County Farm.

DIVISION OF FORESTRY
Ralph F. Wilcox,
State Forester.

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STATE OF INDIANA
THE DEPARTMENT OF CONSERVATION

CONSERVATION COMMISSION

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Department Publication No. 95
Forestry Circular No. 7
July 1, 1930

RICHARD LIEBER
Director

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FOREWORD

By

HARRY G. LESLIE, Governor

State of Indiana

GOVERNOR HARRY G. LESLIE

TWO factors are paramount in the rise or fall of public welfare. The one is natural resources and the other is the attitude of mankind toward them.

It is apparent that these resources should be converted from natural forces and materials into public utilities. To this end the American people have applied themselves for the past two hundred years, with a diligence that has amazed the world and changed an unexplored wilderness into crowded highways and cities. However, the public does not realize the constant assault being made upon the natural resources.

If prosperity is to continue through succeeding generations, then public attitude toward natural wealth must include public responsibility to see that the interests of these ensuing generations are conserved. Legal possession of the land and its wealth is but a passing ownership. It implies joint estate with posterity. Nowhere is this more true than in Indiana. The first generation explored and colonized; the second one subdued the hostile natives and cleared forests to build homes and bridge streams. The last generation has initiated commerce and improved the arts and sciences.

The public has paid a ruinous price for these developments. Today Indiana has two and three fourths millions acres of wrecked woodlands. The better species such as white oak, tulip poplar, ash and walnut have entirely disappeared from hundreds of farm woodlots. Overmature and defective weed trees occupy their places.

Forest fires have damaged promising young stands. Grazing has depleted the woodlots until dense, vigorous forests are the exception, while open stands of unmerchantable trees are the rule. Erosion not only has taken away millions of dollars worth of surface fertility but our hillsides are gashed with deep gullies and the soil itself has been removed. One riding over Southern Indiana by airplane looks down on wasted regions, where the top soil is gone. Over thousands of acres, the land looks yellow and sick as though afflicted with a terrible eczema.

The unregulated streams rise and fall like elevators and are loaded with silt. This forms the river flood problems. Fish, game and the bird life which keeps the insect horde from appropriating our food supply have almost disappeared. Our citizens are leaving Indiana to find an outdoor recreation, which could be provided at home.

A grave economic problem exists in the State, when we import $32,000,000.00 worth of lumber each year, while hundreds of abandoned farms total over a million acres of waste, idle and eroding land and entire counties not only are unable to assist state government, but require aid to maintain standard schools.

Reforestation of waste land, forest fire protection, prevention of soil erosion and the development of private and state owned forests is unquestionably an existing problem, in both state and national welfare.

STATE FOREST NURSERY IN CLARK COUNTY

Evergreen transplants ready for planting on waste land. This nursery contains about ten million trees and will soon supply three million trees a year for forest planting.

USING OUR ABANDONED FARMS

Worn-out Land Planted in Trees Would Supply Future Needs of the Nation and Help in Solving the Problem of the Farmer

By RICHARD LIEBER, Director,
Indiana Department of Conservation

Richard Lieber

IN THE struggle of mankind upward from the days of the cave and cliff dwellers, nature has been a great storehouse from which the necessities of life have been slowly and laboriously secured. The living animals and plants have submitted to cultivation under the supremacy of man. The inert substances such as coal, oil, gas, minerals, rock, soil and water, along with the many other natural resources, have been forced to yield to industrial development.

The standard of living of any human period or country in the world has always depended upon the natural resources available and the ability of human ingenuity to exploit them. They supply the economic commodities which satisfy the wants of civilization.

When populations were small and resources were abundant no organized efforts were ever put forth in order to conserve natural wealth. Such periods were always characterized by profligate waste. For a literal example one only needs to contrast the biblical description of an abounding Garden of Eden with the condition of southern Asia today. According to many authorities, all our deserts have been man-made.

Physically the hills were stripped of their forest cover. The fertile soils were exhausted by agriculture or washed down into the lowlands, rivers and lakes, to be buried later by successive deposits of gravel and sterile subsoil. The water table fell below the point where plant life could appropriate it from the soil to sustain growth.

Biologically the wonderful balance of nature between plant and animal species was overthrown. Bird life disappeared and insect hordes multiplied to devour the dwindling agricultural crops. Races of people have risen to power or fallen into obscurity upon the rise and fall of their natural resources.

Tripoli is a classical example. Once it was a land of teeming population, while today it has been reduced to a few thousand inhabitants. There the rural people live in huts of mud and secure their fuel from twisted straw or dried cow-dung.

The earlier civilizations had little or no knowledge and machinery to utilize more than the most accessible of resources, forests and soil fertility. As these waned the trend of stronger groups was west and north into eastern, central and northern Europe. The Mongolian races could not easily penetrate the mountains, deserts and tundras west from the great Chinese empire.

The decadence of nations has proceeded simultaneously with the destruction of forests for they are the keystone of the great arch of natural resources which supports a destructive civilization.

Norway Spruce Sixteen Years Old as a Demonstration Windbreak and Christmas Tree Planting on Old Abandoned Field at the State Forest, Clark County, Indiana

During the Middle Ages and prior thereto the forests of Italy, France, Austria, Spain, Germany and England suffered tremendous overcutting. It took several hundred years for the growing populations of Europe to pass from a desperate need for forest protection on non-agricultural lands and forest products in daily existence, to the awakening of a public policy of forest restoration and maintenance.

It took France decades of time and prodigious effort and expense to reforest the shifting sand dunes along the Gulf of Gascogne and Pas-de-Calais. Years were spent stopping the torrential erosion and floods coming down from the Alps and Pyrenees mountains to destroy the agricultural lowlands. While a pioneer race were working prodigiously to remove the forest cover of a newly discovered country in America, the people of France, Germany and Austria were striving equally as hard to regain the same resource which they had previously failed to maintain. While thus older countries have been aroused to the necessity of rebuilding the forest resource, America has failed to profit from preceding history.

The lumbering wave swept down from the New England States to New York and Pennsylvania, then northwest through the Lake States, and onward through the Central States and into the great cypress and pine forests of the South. Today the great virgin forests are making their last stand in the Pacific Northwest. In the next three or four decades this great store of nature will have almost entirely disappeared.

One cannot condemn the use of the forest products for they have gone into homes, transportation, industry, warmth and even art and beauty. We do stand, however, guilty before present and unborn generations for the destruction of the recurring possibilities of forestry and agriculture upon the lands we have laid waste.

Why are there millions of acres of potential forest land in Minnesota, Wisconsin, Michigan and Pennsylvania standing as idle as barren deserts? This land once supported heavy stands of timber stocked with all sorts of game and wild life. The answer is human carelessness. Where once grew magnificent trees we find forest fires have robbed the next generation of that wood supply which means so much to us. There fires have taken away time after time the soil cover and fertility needed to sutain new growth. Over vast areas it will be two centuries before this humus can be rebuilt by successive types of smaller vegetation to the point where the land will again sustain a forest stand.

Why are the small woodlots which are so precious to every farm through the agricultural states like Illinois, Indiana and Ohio neglected and ignored both by the landowner and the agricultural leader as a potential crop and therefore a part of farm management? The answer is lack of vision which permits grazing animals to eat up the young trees on the forest floor so necessary to perpetuate species and link one crop of timber with the next one. While busily engaged in building up the quality of grain and animal crops through careful selection and breeding and by eliminating the "boarder" individual, we have been permitting the lumber man to haul away only the best timber, leaving the cull and overmature trees to occupy the site and perpetuate their own inferior kind.

We should ask ourselves another question. Why do the deforested states east of the Great Plains import millions of dollars worth of lumber and other forest products each year when the millions of acres of idle and eroding hill lands in each of these states increases at an appalling rate?

Take for example the rough unglaciated hill lands of southern Ohio, Indiana and Illinois. Once the cradle of these states, they stand today as a great economic problem in land use. As the pioneers came down the Ohio River they pushed northward through the hills. It was necessary to occupy high ground because the low flat lands were undrained and unfit for healthy livelihood. The forests were cleared away and the plough was taken to the hills to turn under the protecting leaves and humus.

The loose soil was exposed to erosion. The fertility was quickly leached away because the lime and nitrates which are basic plant foods are readily soluble in the rain.

Then came dredging machinery and tile to transfer lowlands into fertile grain fields. Governmental projects of expansion in agriculture caused the deserts to produce. Each acre of new soil with its virgin fertility placed several acres of older hill land on a marginal producing basis.

In an effort to feed the world during the World War agricultural expansion was stimulated far beyond normal requirements. With world markets curtailed following the war it was natural for the easily cultivated lands to remain in production while thousands of hill farms could be managed no longer on a profitable basis.

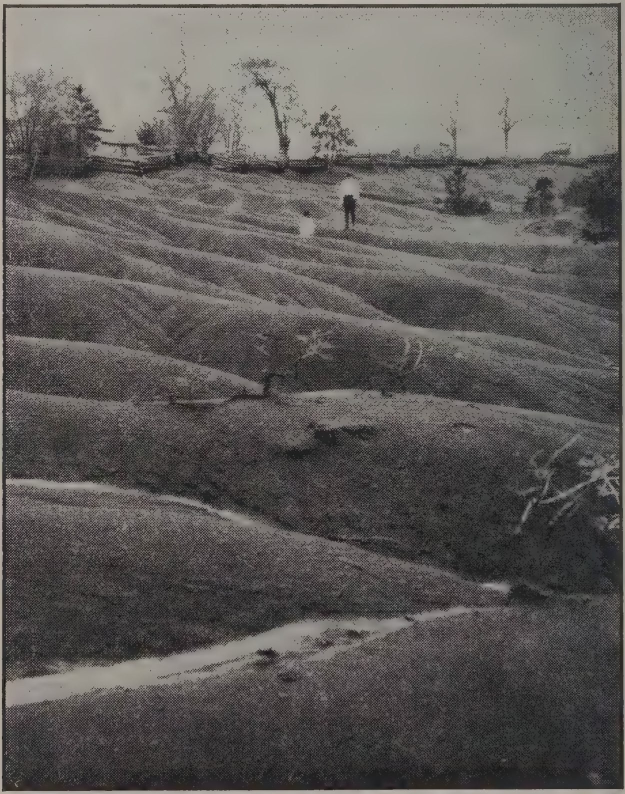
Each abandoned farm in the hills of Kentucky, Tennessee, Ohio, Illinois, Indiana and Missouri shifted a greater burden upon the ones which remained. Schools, roads, eleemosynary institutions and public governments began to suffer from lack of taxable wealth. The thing runs in a vicious circle, for mounting taxes due to abandoned farms cause the rate of migration to increase.

Township roads could not be maintained because taxes were inadequate. The advent of the automobile discouraged both the younger and older generations in the battle with impassable mud roads. Instead of driving in and out to their hill farms, their last trip was only one direction, permanently out!

Schools have suffered simultaneously with roads. The first step was consolidation and this relieved the situation temporarily, at least until roads became so bad in many places that pupils could no longer be transported in and out so the great American migration out of the hills continued.

As townships suffer as integral units, entire counties move to the brink of insolvency.

Educational standards advanced and Indiana offers an interesting example of what is taking place here and in many other states. The state first recognized its duty toward poorer school corporations in 1905 when minimum school terms and teachers' wages were established. In 1921 a relief levy was necessary to aid poorer districts to help pay for tuition, transportation, fuel, janitor service,



An Example of Soil Erosion

Photos by F. M. Hohenberger

Excellent Hardwood Forest Like This Should Cover the Hillsides in Indiana to Hold the Soil as Well as to Keep It Permanently Productive.

supplies and reference books. The legislature in 1925 added aid for equipment and repairs.

In 1926-27 Indiana paid out one and one quarter million dollars in such school aid. Wisconsin for comparison paid six million dollars just for elementary schools.

One can scarcely picture the true economic condition of large portions of many states. Using Indiana again as an example, twenty-nine counties which comprise a third of the land area paid in state taxes for the year 1928 a total of $1,224,867.15. These same counties received back for school aid alone over a million dollars. Their net contribution to state government was $149,632.99.

Ten counties received back nearly three times as much state money as they paid in taxes and one northern tier Indiana county paid three-fourths as much state tax as the entire twenty-nine, yet received no state aid in return.

Many other states like Indiana are waging a losing battle to maintain a population and local government on thousands of acres of worn out and abandoned hill country. State aid is only temporary relief for it only bolsters up the toppling social structure of regions where natural resources such as forests and soil fertility have been exhausted.

The old fields are being abandoned to weeds. Erosion is taking a frightful toll of soil from the hills and dumping thousands of cubic yards of it into the tributaries of the Mississippi River. If we controlled the silt from building up the mouths of our rivers, levees would not go higher and higher and dredging could be curtailed.

The problem of flood control may be one in engineering at the mouth of the river, but the fundamental cause of floods has not been reached until a forest or sod cover is restored to the eroding "deserts" back on the tributaries and small streams.

Many things are apparent to the people primarily active in the field of conservation. The Department of Conservation in Indiana has struck out boldly with a fundamental program of reforestation. In this program we find flood control, school aid, recreation and wild life, industrial independence for wood supplies and even farm relief all have a deep significance.

One Indiana state forest of two thousand acres was purchased in 1903. Subsequent purchases have brought this forest to over five thousand acres. The area is all in forest cover, soil is intact, clear streams come from its slopes, birds and wild life abound, thousands of people use it for health and recreation, and experimental improvement cuttings have shown a net profit of sixteen to twenty-two dollars an acre.

The example is most striking. Applying this experience to the great economic problem of southern Indiana it is offered to the people of this state and to others as well for urgent consideration.

Addressing the problem with a spirit of helpfulness the solution which is being offered is first contraction of county and township units, public acquisition of large state forests and suitable highways to afford reasonable access to the tourist, sportsman and woodworking industry.

The expansion of forest lands would avert the experience of older nations of wasted soils and timber famines. It would remove thousands of acres of marginal producing land from agricultural competition with basic grain and dairying regions.

The cost of the land by the public and its reforestation would be a permanent solution and would be far less in the next century than appropriations for temporary relief and economic idleness.

The states must be conceived as permanent. They must function as guardians of future generations, each building for the existence of the succeeding one. Natural resources which are the means of material existence must be preserved.

The nation would rise in defense of a fractional acre taken from it by a foreign enemy. The public have stood by, however, and permitted a natural wealth untold, namely the forest and its soil, to be wasted, robbed of its fertility, burned and pillaged by its beneficiaries and finally neglected by the individuals who for this short generation happen to hold possession of it. Surely "Where there is no vision, the people perish."

Indeed, we have our hands full if we mean to do justice to our task. But that task can not be completed unless we recognize the fundamental law of all conservation, namely, that no single item thereof can be treated separately. There is no separation in nature where everything is endlessly connected and interconnected with everything else.

We must treat all natural objects as is done now comprehensively because they all have an interrelation.

No single phase of conservation can be considered without immediately reaching into all of its ramifications. It would carry us too far from our subject to cite more than one example. So let us take the tree to show what is meant.

Without trees, we would be deprived of the most universally useful material. We could not carry on our daily existence without the use of wood. From the cradle to the grave we use wood. From houses to matches, from railroad ties to near-silk sweaters, from orange boxes to newspapers, from pyrolignites to turpentine, in endless variety and form.

Without trees our hillsides and river slopes would soon become desert land. It has already so happened in many places with the additional evil of flood water destruction. When the Ohio River slopes were denuded of trees the fine rich soil followed. Ask our farmer friends in the Ohio River bottom what is happening now. At first each flood left good rich soil as a deposit; now he is receiving broken stone, sand and gravel.

Without trees evaporation of needed moisture and exhalation of oxygen fails. Water formerly held by the thick leaf mould rushes off instead of being gradually distributed through many smaller streams of steady flow. Aquatic life will suffer. Fishing streams will dry up.

Without trees no home for the beautiful and useful creatures known as big and small game which once upon a time roamed the fastness of our woods.

Without trees there is no protection for birds from their many natural enemies. And a world without birds would be man's abdication in favor of a wild reign of insects. There are but 18,000 species of vertebrae against 350,000 species of insects.

America is only an infant in comparison with older countries. In the short period of two hundred years we have started down the same broad road to natural poverty which China and southern Asia travelled several thousand years ago. It is the way of the three ex's—exploration, exploitation and exhaustion.

The conservationist stands at the cross roads displaying the danger signals. The business and professional men together with the statesmen who are always leaders of the great public mind should awaken to a greater responsibility and aid in building a conservation conscience.

To palliate and gloss over a bad situation will no longer do. It takes courage to face the issue and real statesmanship to solve the problem.

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